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ABSTRACT

A project to examine the implications of technological change at Northern Telecom consisted of two major components: a technological survey and case study research. A questionnaire that contained more than 90 questions on technological change was distributed through local union technology committee meetings in Brampton, London, Belleville, and Kingston, Canada. Case studies were conducted at the company's plants and offices in the same cities and relied on interviews, documentation, and direct observation of operations. Among the findings were that: (1) job reduction is a profitable activity; (2) more work is expected from fewer workers; (3) new disciplines must be developed that encompass the total process of product design, manufacturing, materials sourcing, scheduling, and customer service; (4) integrated systems eliminate both indirect and direct jobs; and (5) the company's labor force is shifting from workers engaged in production to those engaged in information-based activities, from those who provide direct to those who provide indirect labor, and from bargaining unit to nonbargaining unit jobs. The document includes numerous quotations from workers affected by the changing technology. It is illustrated with line drawings and photographs. (CML)

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BY
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OCTOBER 1989

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Changing Technology & Work: Northern Telecom

CAW TECHNOLOGY PROJECT

BY
DAVID ROBERTSON
JEFF WAREHAM

OCTOBER, 1989

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October 1989

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PREFACE

This report is an abridged version of a longer, more detailed document entitled *Computer Automation and Technological Change: Northern Telecom*, which was prepared in January 1988 and is available from the CAW. The current effort is an attempt to make some of the discussion and analysis in that report more accessible. As with the former report, this one relies extensively on the perceptions and perspectives of those who work at Northern Telecom.

Since writing the initial document, *Computer Automation and Technological Change: Northern Telecom*, much has changed in Northern Telecom. Northern has announced the closure of the circuit board plant in Belleville, corporate executives quoted in the present tense have since retired or been replaced, and new projects, such as 'Greenfield' in Brampton — which will dramatically change production flows and jobs — have been initiated. But for all those changes and despite the snapshot character of the specific descriptions, the themes and issues around which this report is drafted remain central to the processes of change at Northern Telecom.

The CAW's Technology Project study on the impact of technological change at Northern Telecom was conducted with the financial support of Labour Canada's Technology Impact Program (TIP) and completed over a 10 month period beginning in March 1987. The purpose of the project, broadly speaking, was to examine the implications of technological change for CAW members in Northern Telecom. And while reference is made throughout the report to Northern Telecom, the study is directed only at those Northern locations represented by the CAW.

Project Methodology

The project consisted of two major components: a Technology survey and case study research. A survey of approximately 10% of the CAW office and plant membership in Northern Telecom was distributed in June of 1987 and analyzed in the fall of 1987. The intent was to sample a sufficiently large group of bargaining unit workers at Northern to permit statements and observations concerning the impact of technological change on a variety of work related issues. The questionnaire was extensive and included over 90 questions on a range of technological change issues. Surveys were distributed through the local union technology committees in Brampton, London, Belleville and Kingston. A detailed summary of the survey findings is available under separate cover while general trends and findings inform the final report.

Case studies were conducted in each of the Northern locations in Ontario, one in the Brampton office, one in the Brampton plant, one in each of the London office and plant, and combined plant/office case studies in Belleville and Kingston. Financial limitations prohibited a case study of the Saint John facility. The structure of each case study varied somewhat from location to location but all shared the same basic elements and addressed the same set of issues.

The case studies relied primarily on three sources of material: interviews, documentary material and direct observation of operations. The interviews consisted of a combination of Cabinet level plant management (in group format), departmental management, local union representatives and workers (both individually and in focus groups), and varied considerably in format and length. Documentary information included a range of material from each location, as well as formal Corporate presentations to the union. The final source of information was direct access to Northern plants and offices and on-site observation. The opportunity to follow the flow of production, both in the plant and in the office, and to stop and discuss the products and issues along the way was a fundamental reference point for the study.

Acknowledgements

The project in general, and the researchers in particular, are indebted to a great many people. Unfortunately it is not possible to thank everyone individually — doing so would add a list of names that rivals this report in length. Particular thanks, however, go to members of the CAW/Northern Telecom Intra-corporate Council, to the local unions in each location and to members of the local technology committees for their patience, effort, guidance and moral support throughout the project.

Thanks is also extended to Northern Telecom management for granting access and for their participation in the study. But a special debt is owed to all those who endured the endless questions, who filled out the survey, who spent hours of their time arranging interviews and meetings and who participated in interviews and focus groups, and who made the case study visits not only informative, but enjoyable. This study could not have been completed without your help.

David Robertson
Jeff Wareham
July 1989

INTRODUCTION

The present conjuncture is one of dramatic organizational and technological restructuring at Northern. Computer based automation and new production methodologies are producing some of the most consequential changes ever seen by those who work for Northern. Some of the changes at first appear relatively minor: in Belleville a production control clerk formerly in an office out front is now working from a desk on the shop floor in a manufacturing area; at London a plant stockroom worker uses a computer terminal to enter inventory data directly — a job that used to be done by a worker in the office. Other changes are more dramatic and graphic. In the Brampton plant the area of the shop that formerly housed the heavy stamping presses that bashed out metal for the old crossbar switching units is no longer needed for manufacturing. Instead it has been converted to office space occupied by clerical workers and managers. But all the seemingly small changes and all the significant changes, at every level of the organization and at each production facility, have combined in an enormous transformation.

The current period is a watershed in the history of manufacturing. The converging technologies of computers and telecommunications are reshaping production and the base of economic activity. Some observers argue that silicon and information have combined to form a new heartland technology, one whose impact will be as far reaching as steam power, railways, electricity and the automobile. Northern Telecom, both as a producer and as a user of the new technologies, is at the forefront of these changes.

In a computer integrated world physical space, tasks, time and the activities associated with the plant and with the office are changed. What were formerly distinct and separate functions in manufacturing, design and administration begin to overlap and their boundaries blur; what were established procedures, traditions, methodologies and strategies are altered; workplace relationships are modified, the content and meaning of work is redefined and the requirements for labour are changed.

The changes at Northern are incredible, both in extent and in scope. In less than a decade, and within a single generation of workers, the products, processes, procedures, the equipment, the skills and the composition of the workforce have all been affected by technological change. One executive points to what he sees on the horizon:

> "It won't be long in a manufacturing sense, when we will be able to program orders in London, England, key in the orders and have them come out into a computerized integrated manufacturing facility in Belleville, and within seconds have a machine start to produce the product. This will have incredible implications for how we manufacture products and do business."

Obviously where you are in an organization affects your perspective and your attitudes. Compare the above boardroom perspective with the limits imposed on the perspective of a worker who, when asked to comment on the changes in the plant, admitted she could only comment on the specifics in her one area. As to the extent and nature of changes elsewhere she explained:

> "I don't know because I don't get to see that much of it really. When you're on the line you get a 10 minute break in the morning and afternoon and the 1/2 hour for dinner. I've been here 22 years but when you're on the line you don't get out into other parts of the plant."

There is a difference of perspective between managers and workers, not only in terms of what is seen but in terms of how it is viewed. In the present report we try to explore these differences in the context of technological change. The report is approached from two broad sets of questions. The one has to do with what technological change is, the factors which foster change, the way it is introduced and the corporate strategy which motivates and directs it. The other set of questions asks about the impacts of technological change on jobs, workers and workplace relations.

CHAPTER ONE:

TECHNOLOGICAL CHANGE AND SHIFTING LABOUR REQUIREMENTS

Jennifer works on the line in an area adjacent to the robots. For her the relationship between technology and jobs is as clear cut as it is alarming. "It's scary watching the automation next to you," she confides. "You know you're next. They're going to get your job eventually."

At a different plant in a different city another Northern Telecom worker expresses a similar reaction. For Victor the issue is also one of growing job insecurity: "You go home on Friday and come in on Monday and all of a sudden there is this monster sitting there that's going to do everything that I have done, but not go for lunch or take a coffee break or anything else that I do."

For Jennifer and Victor the role of technology in changing labour requirements is obvious. At other times, however, the causal chain is tangled in other factors. But even in those situations when causal relationships are not clear, outcomes can still be described. At Northern Telecom labour requirements are changing. The *demand* for labour is changing, the *distribution* of labour is changing and the *composition* of the labour force is changing. Behind these developments are the converging elements of technological change; changing product designs, changes in machinery and equipment and altered procedures and processes.

What follows, in this first chapter, is a series of observations which explore the changing requirements for labour in Northern Telecom and the importance of procedural innovations and computer automation in driving those changes. The transitions occur in a context shaped by corporate policy and this is the starting point for the following observations.

OBSERVATION #1: THIN IS PROFITABLE

Corporations are engaged in an aggressive effort to contain staff numbers, what some in management refer to as creating "thin organizations." And Northern is a charter member. At corporate H.Q. Northern's manufacturing strategy gets expressed as adding value without adding cost. In the offices and plants the diet plan gets interpreted to mean cut cost.

Throughout the Northern organization there is a preoccupation with the "head count", an overiding emphasis on cost improvements or "CIs". As one manager explains:

> "We have goals and objectives for our people. We have product cost reductions. We have objectives set at corporate level. We have to look at employee levels everywhere."

In such a context job reduction, while predictable, is not always a direct effect or even a necessary outcome of technological change. It is often a product of managerial intent. Management's cost-cutting ideology has treated technology as a diuretic and has created a cycle of computer dependency. Without computer based automation the ranks could not be kept 'so thin': In turn, 'reducing head count' is a powerful justification for adopting new technology. A Northern manager presents the corporate edition of the riddle about the chicken and the egg. In this case, which comes first, 'technology' or 'job loss'?

> "Very seldom are my projects related to head count . . . (Our automation efforts) never respond directly to a downsizing pressure. Now what probably does happen is that those who are left have a lot of work to do and suggestions are made, there will be identified improvements in how to make their jobs easier. So when business picks up again there may be a tendency to need less people because of the improvements in productivity. It's just the way the business works."

The corporate rationale for adopting advanced office, design and manufacturing technology is straightforward. In boardroom terms automation is the road to the twin destinations of increased productivity and reduced costs. Northern uses situations of technological change — new product designs, automated equipment and changes in work procedures — to reduce labour content and increase profits.

OBSERVATION #2: MORE WORK BUT FEWER JOBS

Management is quick to argue that everyone at Northern owes their job to new technology, a claim which does little to reassure anyone outside of management. Instead workers face it as a technology paradox — technology may save the operation but it might cost their jobs.

What can be seen at Northern is job decline. What can be hoped for, at best, is jobless growth — a trend where corporate growth is required just to hold the line on jobs rather than to make employment gains. A manager discusses the trend.

> "The volume of work can go up dramatically. In the past if you would add x amount of product you would add x amount of people. Not anymore. It (technology) reduces the need for people. We won't be creating the jobs."

Labour is diplaced wherever computer based automation replaces conventional processes. When new technology is introduced substantially fewer people are required to produce the same level of output. This is true whether the measure is telephones, design drawings or invoices and whether the application is in plants, administrative offices or technical departments. Northern's impressive productivity gains provide the evidence.

In The Plants

— At London, in 1981, 1725 hourly workers produced 1 million telephone units. In 1987 909 hourly workers produced 1.8 million units. Staff has been cut almost in half but output has almost doubled.

— At Kingston the old extruder lines had a throughput capacity of 3500 - 4000 feet per minute. The new extruders are capable of 6500 - 8000 feet per minute. On the old lines there was one operator for every line plus a helper for every two lines. Now there is one operator for every two lines and a robot that serves all the lines.

— At Belleville Sydney St. the introduction of new computer controlled, semi-automatic machines (Royonics) used in circuit pack assembly cut the labour time in half for certain printed circuit boards.

— At London the new automated plastic moulding presses require only one operator for every two machines. The old presses had one operator for every machine.

— At Brampton the FMS line currently produces, on average, 25 circuit packs per hour with approximately 24 people — roughly 1 pack per hour per person. It would take one circuit pack assembler 4 hours to build the same pack the old way.

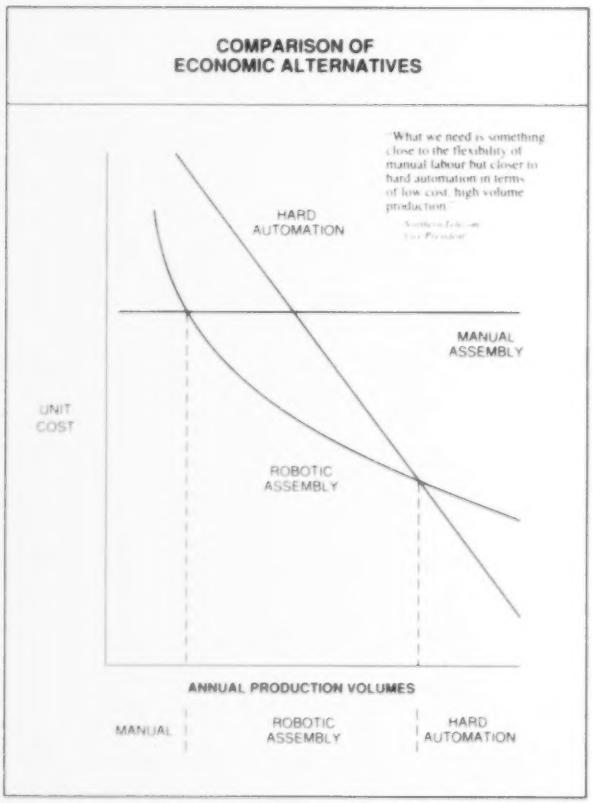
In The Offices

Computer techniques and methodologies have made many clerical tasks easier to accomplish, quicker to finish and, as office workers are quick to admit, they have made workers demonstrably more productive:

> "The way we used to do it we virtually had to sit down, get a drawing, list all the components onto a sheet of paper, put the quantities down beside it, look each cost up in the cost book, write each cost down, extend it, build the missing cost, total it, add the labour manually in each item, add the labour to the material value and come up with a standard cost. That used to take me an hour to do one item. I can build a 'standard' now in less than a minute on a terminal and it's more accurate than I used to be."

> "Standard costs for products is sort of a spreadsheet function. Everything is fed into the system, you set it up, press the button and it runs the cost. You get the cost for a telephone set out in 15 minutes where it used to take 3 days hand writing it."

Staff numbers in particular office departments are down. The change is especially evident in certain job groups — data processing, expediters, secretaries — where the link with computer automation is particularly strong. But the impacts of new technology are felt more generally. It seems that in every Northern office there used to be less work and more people and now there is more work and less people.



"In purchasing there were four girls and now there are only three. When they brought in the computerized system for the buyers one wasn't needed. Now there are even two less buyers."

"At one point we probably had 10 or 12 people looking after $25 million. Now we have 3 people looking after $125 million."

In The Technical Departments

The Technical departments conform to the pattern. Here Computer Assisted Design (CAD) is the major technological innovation. At Brampton, management points to average CAD productivity ratios of 3:1 over conventional methods. At London specific CAD applications such as repetitive tool design have resulted in productivity ratios as high as 7:1.

CAD has reduced labour in two significant ways; first, through productivity improvements — improved designs, decreased design time and reduced design costs, and second, in the elimination of many clerical activities associated with design — typing, copying, filing, information retrieval, even the mailing and transmittal of designs. CAD also leads to a reduction in design errors and the need for design changes. In other words, not only is it faster to process the changes, CAD actually decreases the need to do so. As one worker expressed it:

"It was much slower with the manual drawing to lay-out components. We can do a job in 8 weeks that used to take us half a year before."

OBSERVATION #3: FROM DIRECT TO INDIRECT LABOUR: BROADENING THE IMPACTS

At Northern the driving factor in automation is cost. And cost, at least initially, is most visibly represented in direct labour. Today many of the jobs directly involved in production have been automated and direct labour is a shrinking factor of production. Nowhere is direct manufacturing labour more than 10% of factory costs and in most places it is actually lower. For instance, at Belleville Sydney St. 85% of component assembly is accomplished with automated processes and direct labour is now only about 6% of the cost of production. Ten years ago it accounted for around 16% of the cost.

From Northern's initial concern with direct labour there has been a progressive broadening of the reach of automation. Like a stone thrown into a pond the waves of technological change extend in ever greater circles affecting more and more workers.

As direct manufacturing labour was reduced, indirect manufacturing jobs emerged as targets — particularly jobs in inspection, testing and material handling. As indirect manufacturing jobs were reduced the indirect jobs in the non- manufacturing functions, what management refers to as non-value-added jobs, have become the focus. The company President explains the objective:

"To begin, direct labour is a decreasing share of our value-added product cost . . . The implication for Northern Telecom is clear. The relatively easy productivity and quality gains — the automation of simple, repetitive tasks — has become a given . . . To increase our value-added and profitability, we must extend such gains and develop new disciplines that encompass the total process of product design, manufacturing, material sourcing and scheduling and customer service."

Northern's strategy for dealing with indirect jobs is a mixed one. It involves computer automation and procedural innovation; it has meant pre-automation process changes and post-automation job changes. And it proceeds on three tracks;

1) reducing the activities associated with indirect labour,
2) transforming indirect labour into direct labour, and
3) applying computer automation to indirect functions.

1) Reduce Indirect Labour Activities

Just in Time (JIT) production has provided many of the procedural innovations for reducing indirect labour activity. Flow lines, inventory reduction and KANBAN techniques have combined to reduce the 'count-move-store-expedite' pursuits and the staff engaged in those functions. Flow lines have reduced the need for kitting and those whose job it was putting the kits together. Less buffer stock has reduced the need for people to transfer and count parts. Smaller lot sizes and relocating production operations closer together has meant less scrap and less need for people engaged in inspection and repair. And fewer parts to build and purchase means fewer parts to track and fewer workers to do the tracking.

2) Make Indirect Labour Direct

A second aspect of Northern's strategy involves converting indirect and support functions into direct, value-added production. This is accomplished when direct labour — the operators or assemblers — are given more responsibilities through additional job duties or broader job classifications. It occurs, for instance, when machine operators perform minor maintenance and repair functions or when assemblers perform inspection functions.

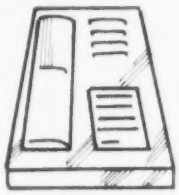
3) Apply Computer Automation

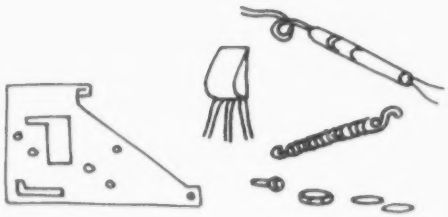
The third element involves the direct substitution of technology for workers. It can be illustrated through the introduction of computerized equipment in Inspection and Testing.

The production of Northern's products — digital switches, PBX's, telephones, circuit boards — is testing-intensive. In certain operations up to half the total time spent producing is taken up in testing. In order to cut production time management wants to reduce the overall number of tests performed and it wants to reduce the time required by individual tests. In both cases that has meant the application of more complex computerized testing equipment. As one tester explained, a new test set introduced at Brampton performs the testing functions of three formerly separate testing jobs, and it does so in less time:

ELEMENTS OF TECHNOLOGICAL CHANGE

PRODUCT DESIGN





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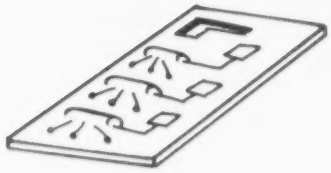
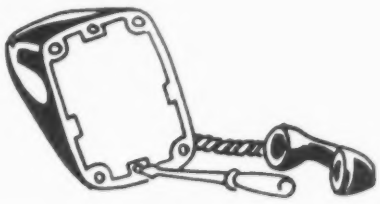
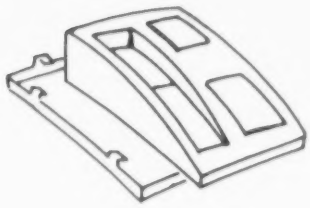
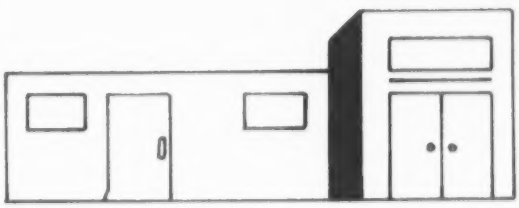


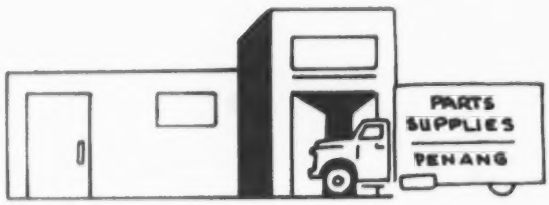


DESIGN FOR ASSEMBLY

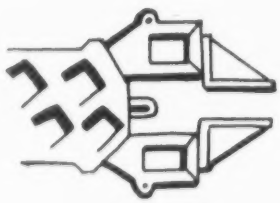


OUTSOURCING

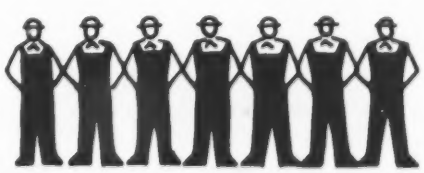


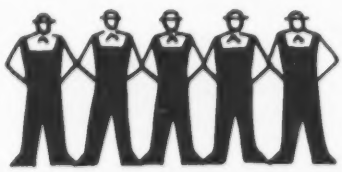


AUTOMATION



FEWER JOBS





There have been enormous changes in the telephone since 1982. Together these changes have resulted in a 79% decrease in the labour time that it takes to produce a telephone. Before it used to take 28 minutes to produce a phone. Now design changes, fewer and easier to assemble components, increased purchased content, new work configurations and automation have got the labour time in a telephone down to only six minutes. With ongoing developments in each of these areas Northern plans to reduce labour time to four minutes.

"We have these new single stage test sets that replace five of the previous sets. It can troubleshoot everything in five minutes whereas before it would take maybe two or three hours."

For testers the pressure to eliminate tests and cut testing time with new equipment has meant layoffs. Those who remain are worried about the future. A tester offers the following prediction:

"We have maybe 600 testers right now. I wouldn't be surprised if three or four years down the road we have 50. They're trying to eliminate them all."

OBSERVATION #4:
INTEGRATED SYSTEMS: ELIMINATING BOTH DIRECT AND INDIRECT JOBS

This point relates to the preceding one but instead of focusing on the job activities the perspective here shifts to the technology.

The development of computer automation, while not an even nor pre-determined process, typically progresses through three phases. Starting with stand alone automation (i.e. robot), it develops through islands of automation to computer integrated systems. Labour displacement is much greater, even though much less apparent, in computer automated systems than in those situations of discrete task substitution. In the development of automated systems — the combination of computers and telecommunications — the impact on jobs is multiplied. In the case of the Flexible Manufacturing System (FMDC) at Brampton, for instance, not only are some of the direct jobs displaced but the co-ordination and manufacturing support requirements are substantially reduced. The staff associated with transporting work-pieces, preparing schedules, recording data, accounting for parts, tracking work orders and similar activites are no longer required in an automated system. As a result, whereas a robot or another piece of automated equipment reduces the need for manufacturing staff, the impact on jobs associated with the development of automated systems crosses over into administrative and design functions.

In general the need for manufacturing support people — production schedulers, expediters, QC, clerks, kitters, fork lift operators — is reduced through the automation of decisions concerning schedules, quality, movement of parts, and product output, but it is also reduced through the integration of processing functions. Similarily the need for design support people — drafting, analysis, reproduction, documentation — is reduced through the integration and automation of design functions.

* * * * * * *

The application of computer based technologies, the introduction of procedural innovations such as JIT and the development of integrative technologies and techniques (CIM), taken together, have reduced the need for both direct and indirect labour. In all cases it is the achievement of the new "more with less" manufacturing philosophy — the corporate variant of having your cake and eating it too — more output with fewer workers, more quality with fewer QC workers, more accounting with fewer people in accounting, more production control with fewer production controllers, more information with less data processing, and so on.

But changing the demand for labour is only one of a set of changing labour requirements at Northern. The others involve the composition of Northern's workforce, its distribution and the shifting lines of job responsibilities.

OBSERVATION #5:
THE CHANGING COMPOSITION OF LABOUR

Northern is in a transitional period, one reflected in the shifts from hardware-based products to software-intensive systems, from manual operations to computer automation, and in the shift of emphasis from manufacturing to product design. These shifts have not only changed Northern's need for labour, they have altered its composition.

Northern management plots its future course as one of moving steadily up the technology ladder and it associates that climb with a different type of worker — the 'knowledge' worker. Northern's Vice President of Human Resources described the change for the corporation as a whole:

"We have had a significant change over the last decade in the number of people who are what we call management knowledge workers. These are people who contribute to the corporation and add value to its operations by manipulating data, thinking and creating things. From something like 32% of our work force back in '77 they will comprise about 60% in 1987."

The shifting composition can be seen is a variety of developments:

— Certain functions such as design, marketing and customer service are assuming greater relative importance in Northern.

— There is a shift from workers engaged in production to those enganged in information-based activities.

— There is a shift from direct to indirect labour.

— There is a shift from bargaining unit to non-bargaining unit jobs.

The changing composition is true not only for the organization as a whole but within its various locations. An example from the London office underlines the point. In 1981 the non-managerial staff was composed of 51% clerical, 26% technical (ET) and 23% professional (non-bargaining unit). By 1987 the composition had changed to the point where only 40% of the total was clerical. The ET ranks increased to 32% and the professional ranks had expanded to 28%.

The changing composition can also be seen at the level of particular job functions. Computer automation is often an occassion for management to change the technical composition of the workforce. The introduction of Computer Aided Design (CAD) to Northern design departments is precisely such a situation. Currently CAD operators — in terms of experience, background and qualifications — are a mixed group. Some operators are

relatively recent new hires out of community college while others are draftspersons or tool designers of long service who have successfully made the transition to the new technology. Whatever the current occupational structure, the trend is overwhelmingly away from clerically graded drafting jobs to college trained technicians. Throughout Northern drafting workers are being replaced with ET CAD operators. As one worker described it: "There is drafting but no draftsmen." In fact CAD, perhaps more clearly than any other computer technology, has virtually eliminated an entire occupational group.

The displacement of drafting workers is a two stage process. First, the productivity increases associated with CAD and the ability of engineers and professional designers to do more complete designs themselves at CAD terminals reduces the need for bargaining unit workers. In some locations this means an actual decrease in the 'headcount' while at other locations it means 'future staff avoidance.' Second, it gets expressed as a shift in the occupational structure, and here Northern's preference for recently graduated technicians rather than internally retrained workers is apparent.

Although each Northern location is somewhat different, the pattern is a general one; there are fewer draftspersons, and computer drafting is becoming a technical job.

OBSERVATION #6:
CHANGING DISTRIBUTION: FEWER JOBS — HIGHER GRADES

When computer automation is applied to specific production operations the result is not only fewer jobs but a different distribution of jobs. Some jobs are eliminated, other jobs appear for the first time and the remaining jobs are often different in terms of skill, grade and functions than those that were there before. In a manufacturing context the changing mix of labour can be observed by comparing those areas of a plant where manual operations and automated production co-exist and/or by comparing the composition of the workforce before and after automation. Examples of each from Northern's Brampton plant illustrate the changes in labour distribution prompted by computer automation.

Line Cards

Line cards are small circuit boards used in DMS (Digital Multiplexing Systems) central office switches to assign phone lines to subscribers, route calls and to provide some enhanced telephone features. The relevant operation for comparing the pre- and post-automation composition of the work force is component insertion. In the production of line cards both automated and manual operations co-exist. The high volume card is run on the automated line, the low volume and more complicated cards are assembled on the manual slide line.

The distribution of the workforce is quite different on the two operations. The automated insertion line is a 10 station integrated line that includes nine robot insertion cells and a pre-wave inspection station. It is staffed by two grade 6 set-up/troubleshoot operators, one on each side of the line. In addition the area has two dedicated electronic technicians — a cross between electrician and machine repair — who look after the robots in the automated insertion and in the line card test room.

On the manual side of the operation assembly is conducted on a slide line staffed by eight grade 2 assemblers (June 1987) with one grade 6 lay out worker. Both the manual and the automated line has a pre-wave inspector, formerly a grade 5 repair operator but now a grade 2 inspector.

FMDC (Flexible Manufacturing Development Centre)

The introduction of computer automation in the FMDC area changed the mix of the workforce and increased the proportion of higher graded jobs associated with circuit pack assembly. In a traditional manual assembly department at Northern upwards of 80% of workers are typically in the grade 3 or 4 categories. In the FMDC over half the workers are grade 6 and 7 (over 90% are grade 5 and up). In addition there are two dedicated

CHANGES IN GRADE DISTRIBUTIONS: NORTHERN TELECOM

GRADE	LONDON PLANT		LONDON OFFICE		BRAMPTON PLANT		BRAMPTON OFFICE		BELLEVILLE PLANT		BELLEVILLE OFFICE		KINGSTON PLANT		KINGSTON OFFICE	
	1981 %	1987 %	1981 %	1987 %	1981 %	1987 %	1981 %	1987 %	1981 %	1987 %	1981 %	1987 %	1981 %	1987 %	1981 %	1987 %
Low	67.6	64.7	27.4	20.9	25.7	16.1	30.9	21.7	43.1	28.1	37.6	30.8	8.6	9.4	33.3	23.7
Middle	29.7	32.5	21.3	24.4	57.8	61.8	29.0	37.5	48.0	58.9	27.4	31.4	87.9	85.4	38.5	39.5
High	2.7	2.8	48.8	52.3	8.4	13.5	32.9	34.0	8.9	13.0	34.5	35.7	3.6	5.3	28.2	36.8
Top			2.3	2.3			7.1	6.6			0.6	2.1				
Trades (% of production)	6.0	7.9			No Data Avail	No Data Avail			4.7	6.6			12.4	11.6		
ET (% of clerical)			70.0	64.0			78.9	81.3			70.7	86.4			51.3	39.5
15					8.1	8.6										
	Low = 21,22,23 Mid = 24,25,26 High = 27,28		Low = 53,54,55 Mid = 56,57,58 High = 59,60,61 Top = 62,63		Low = 2,3 Mid = 4,5,6 High = 7,8,9		Low = 53,54,55 Mid = 56,57,58 High = 59,60,61 Top = 62,63		Low = 22,23 Mid = 24,25,26 High = 27,28		Low = 53,54,55 Mid = 56,57,58 High = 59,60,61 Top = 62,63		Low = 22,23 Mid = 24,25,26 High = 27		Low = 54,55 Mid = 56,57,58 High = 59,60	

electronic technicians (so-called 'supertrades') assigned to the area and a number of excluded salaried workers (computer programmers) and engineers spend some or all of their time working in the department.

While the application of new technology in specific departments or particular operations might lead to higher graded jobs, that finding cannot be generalized to the operation as a whole. Instead computer automation can result in a polarized workforce with a gulf between the limited number of higher graded positions and the majority of lower graded positions. At Northern the evidence to date is not overwhelming either in one direction or the other. There are pockets of upgrading and downgrading but the general trend to date points to a larger proportion of the workforce in higher graded jobs. (See box on grade distribution)

OBSERVATION #7: BLURRING THE JOB LINES

In office automation formerly clear divisions between jobs get blurred and duties flow both horizontally and vertically over job boundaries. What were formerly different tasks — i.e. data entry, buying and expediting — are automated into the same job. Technology consolidates tasks and provides opportunities for redefining jobs and for changing relations.

At times this has resulted in lower graded workers in the offices taking on some of the functions previously associated with higher graded jobs. More often it has meant higher graded workers assuming the data entry and related tasks formerly done by lower graded workers. As one worker points out:

> "In scheduling we used to have one individual who 90% of their work was keying the information we had collated on a daily basis. Today that person does zero. Less than three years ago we did no keying at all. Now we do it all."

Another worker expresses some of the consequences:

> "Before data inputing was exclusive, now everybody does it. Everybody in the department can do my job. Before my job was an essential position. Nothing would move without my job. Not so now."

Blurring job lines extends beyond particular departments and beyond the traditional distinctions between administration and production, as can be seen in the growing overlap of previously distinct office and plant jobs. Plant workers on computer terminals are performing duties done exclusively by office workers in the past and office workers at terminals are doing work traditionally performed by plant workers. Since one of the explicit goals of management is to use the new information technologies to integrate different stages of production, situations of job overlaps and duplications will arise more often in the future.

OBSERVATION #8: EROSION OF THE BARGAINING UNIT

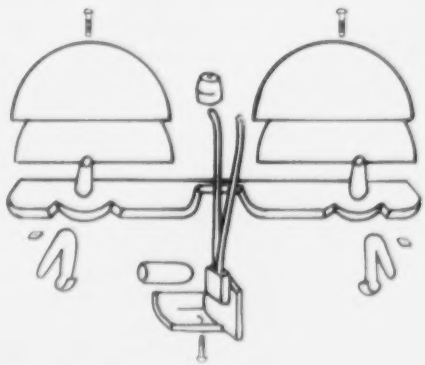
New information and computer technologies change jobs within the bargaining unit. They also provide opportunities to shift work outside the bargaining unit. As there is a discretionary aspect in the creation of jobs, so is there in their elimination. In various office locations workers point to managers who will surplus a bargaining unit employee and bring in a specialist, hire an engineer but not replace an ET (technician) or hire someone for a confidential position, declare a surplus and then not backfill the unionized jobs. Some workers see in this a conscious attempt to get rid of the union and most acknowledge that with computer automation the trend has accelerated.

Managerial or other excluded personnel are performing work that is the responsibility of bargaining unit members. In the clerical fields computers have made it easier to shift work and have made it harder for workers to respond:

> "(In the past) no manager would sit behind a typewriter. Now we are all keyboarders. Its fashionable."

> "Engineers coming out of school all type fast, so if the secretary is busy they'll just sit down and type up their own memo. And chances are the secretary will be busy because they've been cut so much."

THE SHIFT TO ELECTRONICS



"Take the ringer in the old phone. It's gone from 56 parts to one part. We used to have 25 people on 2 shifts making that, plus support in the metal area, plating department and so on. Now you can buy the piezo disk today for 50 cents and it does what the ringer used to do."

"This morning my manager sat at the terminal and sent out a four page memo on COCUS (Electronic mail). If he didn't do that somebody else would have been."

"Managers don't manage anymore. Instead they try to do everybody's work. We would be a lot better off if they just managed."

The threat to bargaining unit work is also evident within the technical ranks, most prevalently with the transfer of ET work to engineers. The trend can be seen in job numbers. Between 1980 and 1985 in Brampton only 20 ETs were hired by Northern. In the two years 1986-7 125 engineers were hired.

While the numbers indicate a shift in the balance of ETs to engineers, the actual transfer of duties is often more direct; shifting current ET work to engineers and giving new work — jobs and tasks that previously were considered ET functions — to engineers. One technician describes the process as follows:

"First the engineer is brought in to help the ET. Then part of the job is given to the engineer. Then the engineer is given the job and the ET is moved out."

OBSERVATION #9: THE FUTURE — MORE OF THE SAME

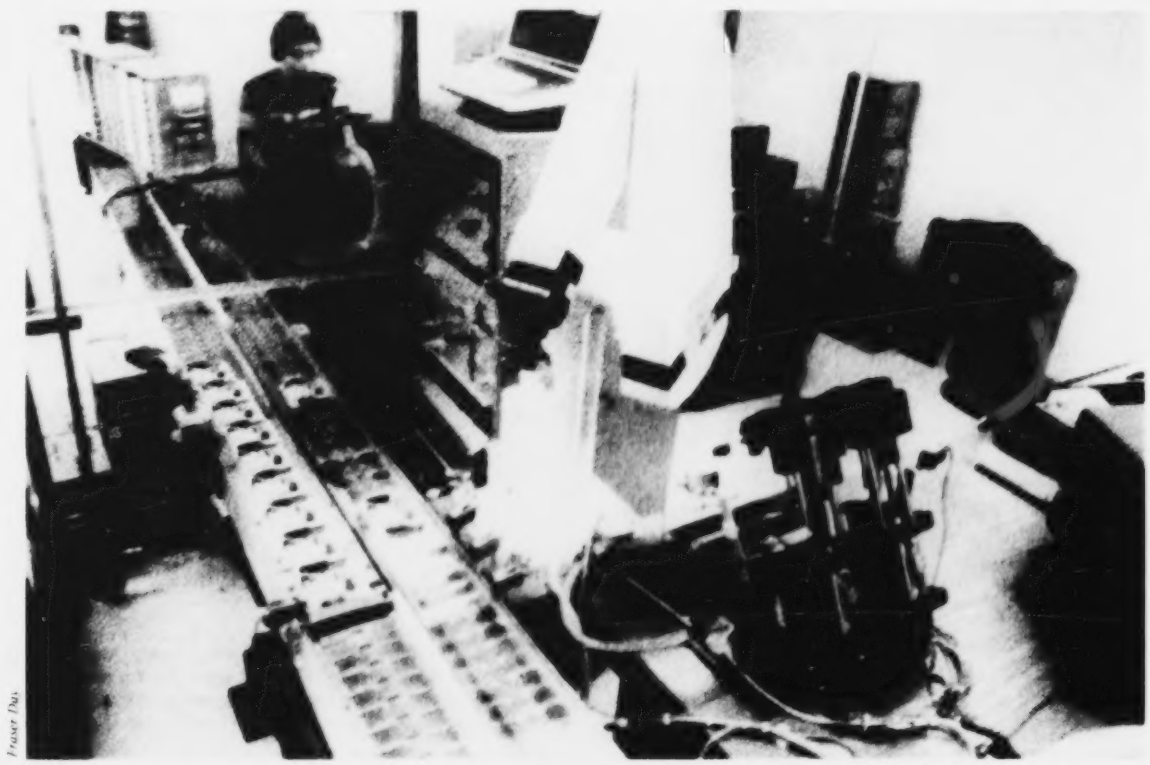
The company expects — *if* it achieves its projected 15% annual sales growth — its total population to be roughly constant through 1992. In other words the company anticipates doubling its sales over the five years 1988-1992 without increasing its workforce. In addition to this pattern of jobless growth there will be more internal shifts. According to senior managers, hourly ranks are expected to decrease slightly and salaried ranks will increase slightly. Within the latter category the company anticipates a slight decrease in managers, a decrease in the clerical and ET ranks and a growth of the professional ranks. Behind these slight shifts in composition are dramatic changes for individual and particular groups of workers.

A Vice President of the company reveals the trauma in store for workers as the company uses technological change to increase sales and productivity and to transform the composition of its workforce:

"I find myself grappling with layoffs involving 20-year employees, and as we break it to the individuals, and as they are going out the door, I almost find myself saying 'by the way, you have a son at Waterloo in computer engineering, can you send me his resume, because I'm short of those kind of people'."

Given these attitudes it is hardly surprising when people report that technological change has increased their sense of vulnerability. "My job", reports one worker, "has never been more insecure." And the threat holds little regard for what workers view as their most important protection — seniority:

"What's the future? Scary. I don't think I'll have a job. I've got 15 years seniority and I'll never retire from Northern Telecom, guaranteed."



Fraser Dai

CHAPTER 2:

MANUFACTURING STRATEGIES AND EMERGING METHODOLOGIES

In Northern Telecom there is a sense of urgency. The corporate culture is infused with it. There is an urgent requirement to reduce costs, inventory and lead times and an urgent requirement to increase profits, markets and productivity. Fuelling the urgency are the new competitive pressures which managers say are shaping Northern. Sometimes it is phrased in the abstract as "the Competition". At other times it is identified as this or that particular corporation, but everywhere the reference is a compelling one: Northern, it is argued, has to adapt to life in the fast lane. Technological leadership is no longer limited to a few companies or countries. Product life cycles have been drastically reduced. Innovation is accelerating and product manufacturability is becoming as important as product capability and service as important as design. In every product niche the competition is hot, and the way the company tells it, it's getting hotter.

Production in Northern plants is more market driven than ever before and, in turn, local managers are more driven by the market. At the London plant managers curse cheap telephones from Taiwan and the combined threat of cheap labour and high technology:

> "Go offshore, you look at those guys . . . it scares the shit out of you. You go into a telephone plant and you see automation. Labour's cheap but they are automating . . . They're catching up with us on automation."

London is not unique. At Brampton, home of the leading edge DMS-100 switching system, managers are now furtively looking over their shoulders. At Kingston managers talk about the price competition being "intense on PIC (insulated cable) and growing on SWBD (switchboard cable)" and they talk about a future that is "unpredictable". At Belleville the story is repeated. In the Sydney St. location managers talk about "making people aware of our vulnerability." The Bridge St. electronic circuit board plant was losing money and managers there wondered how long the parent company would carry a losing operation. In announcing the closure of the Bridge St. operation in the spring of 1989, head office made the answer clear.

PRODUCT LIFECYCLES

In the latter half of the current decade Northern is faced with some difficult tasks. One is protecting itself against an all-out, head-to-head assault from competitors such as AT&T. Another is adjusting to a changing market environment where product technology is no longer the primary basis of differentiation.

In telecommunications any successful product developed by one company quickly becomes the target for imitation and duplication by other companies. The gap between market leader and competitors is getting narrower all the time. It is not enough to have the research and development and the technical wizardry. Those factors have to be translated, and translated quickly, into customer orders. In telecommunications product lifecycles have been dramatically reduced. The old basic black rotary dial series 500 telephone was a standard item for decades. Even the Contempora enjoyed a 16 year life cycle. But that is history.

Today the life expectancy of a new system, whether it be telephones or switching systems, is much shorter than in the past. A telephone is designed and introduced with the expectation that its life is to be no more than three years. In switching systems the old Step-by-Step, introduced around 1920, had a market life of 30 years, and the next generation, Crossbar, had a 20 year life expectancy. Now the product cycle is greatly compressed. The second generation of digital central office (CO) switches, for example, had a market life of about five years. The third generation is just now on the market. In the office market the life cycle has been extremely short. The SL-1 private brach exchange (PBX) lasted only 2 years before it was replaced with a modified product. Its predecessor, the Pulse, was on the market from 1972 to 1982.

MANUFACTURING STRATEGIES

The workplace changes in Northern plants and offices reflect the changes in Northern's products, its markets and the strategies management has adopted to respond. Tighter design/production intervals, more innovations in product design, faster and more defect-free production are all viewed as the ingredients of continued growth and corporate success. New process technologies, new equipment, new information systems and new work management concepts have all been conscripted to serve in the war against interval and the fight for product portfolio.

Management at Northern is consciously reshaping production. Indeed the sense of urgency, combined with new equipment technologies and a new managerial theory and practice, represent a potent force for change. In the current period there are two production philosophies that are fuelling managerial efforts: One is Just-in-Time production (JIT) and the other is Computer Integrated

Manufacturing (CIM). The former is a package of manufacturing objectives, procedures and methodologies directed at streamlining the production process and eliminating 'waste' (activities that do not add value to a product) from production. The latter is a production concept which sees the computer as the central factor of production, integrating the manufacturing stages as well as the various functional areas within the corporation.

JUST-IN-TIME (JIT)

There are two stages of JIT implementation. One focuses on the production process and applies JIT planning, tooling and equipment techniques. It addresses issues such as reduced set-ups and integrated flow processes and establishes a conducive automation environment. The second stage involves establishing vendor JIT programs which include just-in-time delivery schedules, supplier certification and a fundamentally altered relationship with suppliers and customers. Streamlined production systems and improved supplier relationships, Northern hopes, will add up to dramatic production changes.

When Northern managers describe JIT the conversation is peppered with phrases like 'value-added production', 'problem solving', 'set up reduction', 'stockless production', 'focused factories', 'group technology', 'flow lines and cellular production', 'single sourcing', 'certified suppliers', 'KANBAN', 'flexible manufacturing' and 'line balancing'. At different times JIT is discussed as a goal, as an operating philosophy and as a set of production techniques and procedures. As a goal JIT is an attempt to increase productivity while simultaneously reducing costs. As an operating philosophy it implies a continual effort to improve production — to be always uncovering problems and finding solutions. As a series of techniques it provides a set of prescribed and proscribed practices.

At a training course in Belleville Northern stated its JIT objectives in terms of a system that would result in:

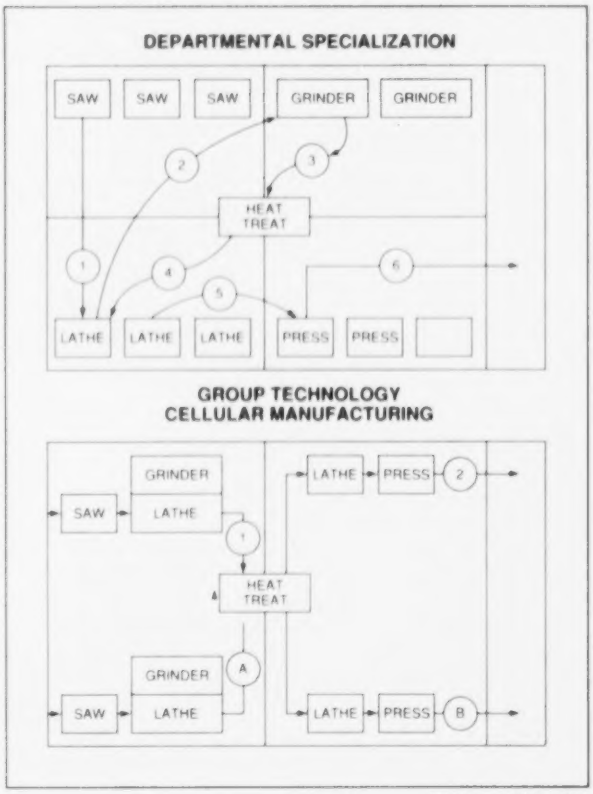
— substantially reduced defect rates,
— substantially reduced inventory,
— increased direct labor productivity,
— reduced space requirements,
— all with minimum capital investement.

Implementing JIT

Northern is serious about its JIT initiatives. Every location has introduced a JIT program and various locations have initiated pilot production projects. The projects cover the JIT waterfront: Kanban inventory controls, set-up time reduction, inventory reduction, supplier and purchasing programs and cellular manufacturing projects.

Pilot Project: Cellular Manufacturing

At Belleville Sydney St. Northern has what is called an integrated cells project. Local management explains the development as a shift away from the traditional 'skill base' organization of production to a 'product base' organization. At Belleville cellular production has meant realigning equipment and functions throughout the operation. Production used to be based on departments:



"In the past", explains one manager, "every pack went through assembly and then it would go to test and then quality." Now the production of circuit boards is organized by product grouping, and management and the workforce is similarily stratified: "We've realigned it so assembly and test are in the system. Where there used to be four or five departments, now there is one." Testing, for example, which used to be a separate department located in a separate room, has been dispersed and integrated into production lines throughout the plant.

Throughout Northern there are a variety of names and related concepts applied to the same set of changes — group technology, cellular manufacturing, flow lines, work cells. The particular name chosen seems to vary according to individual preference and to whether the primary reference is to product groupings, plant configurations and equipment layouts, job functions, or the type of production process and work flow. Developments at Belleville and Brampton highlight each of these changes.

Group Technology refers to the production of a family of similar parts, one at a time and in an equipment layout that links all possible operations in the process. At Belleville the circuit board operations are organized by pack rather than by operation. There is a cell for packs that are called 'common equipment' (CE) and another for 'peripheral equipment' (PE) and the boards that are assembled are all the same size (10.5 X 12 inches), although there can be different codes.

Cellular Manufacturing refers to the equipment layout required in a group technology situation. Since as many of the processes as possible are linked together and the

distance between operations is reduced, it implies the physical realignment of equipment. Equipment formerly in different areas is moved onto the same line. At Belleville the peripheral equipment and the common equipment lines currently share the same wave solder but management is considering purchasing another wave solder so each line can be more effectively integrated and independent. With the trend to cellular manufacturing, equipment policies begin to shift from a preference for large, expensive machines to multiple copies of smaller machines that can be installed in each cell.

Flow Lines refer to a production process where similar or identical products are progressively built and tested one at a time in relatively short manufacturing cycles. At Belleville managers refer to the change in their production flow as "moving away from batch processes where we make 300 and ship them onto testing" toward a "serial, continuous process." In such a configuration physical distances between stations is reduced, work-in-process (WIP) is cut, handling is eliminated, order tracking is reduced, lead times are cut and feedback times (quality) are more immediate.

Work Cells refer to the human organization associated with cellular manufacturing and flow lines. The concept usually implies a small group of workers in close proximity to each other and in a direct work relationship. Instead of

COMPUTER TECHNOLOGY IN THE PLANTS

Northern has applied three related classes of computer assisted manufacturing technology in its plants: Robots, Computer Programmable Equipment and Automated Testing and Inspection Equipment.

ROBOTS

Robots in Northern are used mainly in circuit pack assembly operations where components are inserted into printed circuit boards, and of lesser significance as pick and place material handling devices.

From the early eighties the number of robots at Northern has grown dramatically. One manager pointed out that if you compare the company's robot population to the automotive industry on a robot per billion dollar of sales basis, Northern "is pretty well matching them." But unlike the automotive industry the robots used in electronic applications have much smaller payloads and are more often electronic than hydraulic. Furthermore, at Northern robot applications have developed more rapidly than in other sectors — a development attributable to the size of the robots and the nature of the assembly processes.

When robots were first introduced in Northern manufacturing plants they were used in stand alone operations. One manager explains: "They would go into the workplace, some place would be found where they would do something rather mundane by just picking something up from one place and moving it over someplace else." But since that time the robot applications have become more sophisticated and their applications have rapidly progressed from stand alone operations to flexible system applications, such as in flexible manufacturing lines.

PROGRAMMABLE EQUIPMENT

This category includes a broad range of computer controlled equipment which is based on digital logic and electronic devices. Some form of programmable automation is used at every Northern location and most of it relates to the fabrication stages such as assembly, drilling, moulding and shaping. Currently there are efforts at applying computers to material handling and in set-up and maintenace but Northern's technological emphasis has been on the assembly (and testing) side.

— London, Brampton and Sydney St. use automatic component insertion equipment (standard VCD's and DIP's) to insert IC's into circuit boards.

— Both Brampton and Sydney St. have automatic sequencing inserters which eliminate the need to sequence components onto tapes prior to insertion.

— Bridge St. utilizes tape controlled drills to automatically drill pre-plotted hole patterns on circuit boards.

— New twisters in Kingston allow an operator to change the number of twists per foot of wire simply by keying in a new code.

— Programmable onserters at Brampton place tiny computer chips onto line cards.

— CNC machine tools are used in both London and Sydney St. to machine metal parts, fixtures and moulds.

Whatever the specifics, the common denominator is the application of computer controls and, increasingly, the development of closed feedback loops.

AUTOMATED INSPECTION AND TESTING

Given the inspection and testing intensive manufacturing process at Northern it is hardly surprising that significant efforts have been made to install more computerized inpection and testing devices.

Northern is further along the road of automated testing procedures than automated inpection, but there is evidence of both. Inspection and testing are really two distinct operations. The distinction is of a functional nature. Inspection is a quality oriented activity; it represents a verification of the accuracy of previous manufacturing operations and procedures.

Testing, on the other hand, involves the evaluation of the functional performance and internal integrity of components and systems. Testing verifys the operation of the product itself. At Northern the application of automated testing equipment has taken two forms. One is stand alone test stations. The second is integrated test systems which involve the complete integration of a number of separate testing procedures.

working in a department workers become team members assigned to a cell. The flow of work and the particular content of jobs is changed. When flow lines have been introduced at Northern, in circuit board operations for instance, the build sequence has moved from an autonomous to a progressive build. Manual 'slide lines' for the sequential assembly of circuit packs have replaced the previous practice of individual board build ups in London, Belleville and Brampton.

Work Cells are also associated with attempts to combine and overlap jobs and to make direct labour responsible for more indirect functions such as inspection. In places cellular production is associated with some or all of the following: job rotation, problem solving, cross training and multifunctionality. At Belleville, for instance, assemblers "get and record quality information" and wherever there are slide lines the intention is to have each operator inspect the work of the previous worker.

Behind the new configuration of work and the new job functions are the basic JIT/TQC concepts of "flexibility" and "continual improvement" in products and processes. The concern for flexibility is facilitated by the actual physical alignment of the lines. JIT lines are U-shaped rather than linear or L-shaped. Such a configuration allows for flexible staffing and schedules as well as acting as a catalyst for teamwork and problem solving.

JIT Mission

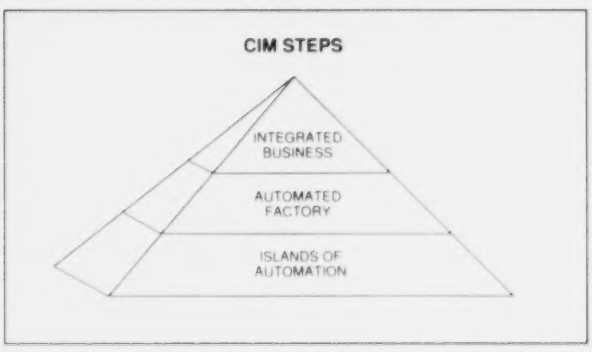
Northern is at the threshold of JIT production and at present different locations are pursuing the issue in their own way and at their own speed. Clearly there are a number of initiatives being taken but it is also clear that JIT is an evolved process. As one JIT manager expressed it: "You get the basic principles, but you have to analyze it and adapt it to your application." But the essential point is that Northern has embraced JIT as a corporate mission and its impacts are being felt throughout the organization.

COMPUTER INTEGRATED MANUFACTURING (CIM)

Converging Technologies

Different workplaces and varied production operations have resulted in a broad mix of automation technologies at Northern Telecom. Northern plants utilize automated electronic component inserters, onserters and sequencers; there are pick and place robots, tape-controlled drills, infrared and laser scanners, process monitors/controllers, programmable 'high speed' test sets, asynchronous conveyors, wave solderers, CNCs, automated injection moulding presses, robotic stock stackers and automated packaging machines. In the design and technical departments CAD systems, laser plotters, desk top publishing units, environmentally controlled photo-tool labs, and a variety of computer terminals (micros and mainframe) are in use. In the administrative and clerical support operations there are wordprocessors, graphic plotters, PC's and mainframe terminals, Electronic mail, local area networks, displayphones, voice/data terminals, PBX's and an assortment of software packages.

On the surface the technologies appear as diverse as the operations. In specific applications they seem as divergent as the products produced and as distinct as the functions for which they are used. But at the heart of the metamorphosis at Northern Telecom are two pervasive and converging technologies: computers and telecommunications. At Northern the computer is used to control a



COMPUTER AUTOMATION

There are a number of general observations which can be made about computer automation in Northern plants.

First, there is a technological uneveness within plants. In any plant there are areas of advanced automation and pockets where production looks much like it did years ago. Such technological uneveness increases the complexity of plant operations and increases the diversity of work situations.

Second, throughout Northern there has been a tremendous increase in the number of computer-controlled machines.

Third, the various computer controlled machines are becoming more sophisticated in terms of the amount of information they are required to process.

Fourth, there is more information flowing between machines and there is more information co-ordination among devices in a common network.

Fifth, more communication technology is being installed to facilitate data transmission throughout the plant and between the plant and the front office.

Sixth, there is a shift from computer monitoring to the computer control of production processes.

Seventh, there is a transition from computer control of individual machines to the development of computer integrated systems.

The Northern objective is to link automated manufacturing cells into systems and to link shop floor operations with front office management through computer networking. As such new technology represents the integration of the three basic manufacturing activities; the transfer of workpieces (including parts and components), the transformation of workpieces and the control of this transfer and transformation.

wide range of production processes and a great many office operations. In some workplaces the computer is visible, sitting on top of desks or in computer rooms; in other places it is remote from the particular operation or it is buried, in the form of a microprocessor, in the machinery. The computer is used to control machinery and equipment that 'do the tasks' of work. They record, sort, analyze and calculate data, draw, plot and model designs. Some load and unload, mould and drill, apply coatings and sheathings, move and manipulate, fasten and assemble. Others measure, monitor, inspect and test the various parts, processes, sub-assemblies and finished goods.

At Northern the application of computer technology has developed in step with the developments of the computer itself. In offices the major trend can be plotted:

COMPUTER TECHNOLOGY IN ADMINISTRATION

While it is usual to think of information automation as an office-based development, the administration function extends beyond the office. In fact the concept of co-ordination and control is an integrative one. The process monitoring and control features of the FMS in Brampton, for instance, feeds information directly to the office. The use of 'wands' to record bar code data of work-in-progress at various stages on the shop floor directly feeds the co-ordination tasks of scheduling and order tracking. The exponential growth in processing power and speed puts a premium on obtaining equipment that is faster, more cost-effective and with more sophisticated features than last year's model, and one piece of equipment generates demands for other equipment.

TECHNOLOGY APPLICATIONS AND TRENDS

In office-based computer automation there are a number of discernible trends.

1) The first involves the rapid evolution and diffusion of new equipment. Computer technology has progressed along all three information axes — storage, processing and transmission. Information can mean text, data, image or voice or their combinations, and encompasses transactions among people, between people and machines and between machines.

— In the storage/retrieval activities the equipment ranges from photocopiers to laser printers and from microfiche to computer disk storage.

— In the processing functions are successive generations of computers, from mainframes through the mini's and micro's, as well as developments in text generation and presentation such as graphic terminals and desk-top publishing.

— In communication there are developments in telephony, electronic mail and workstation terminals covering voice, text, data and picture transmission.

2) A second trend in the automation of information-based activities is the shift in location and manner of data logging and processing. At all Northern locations there is a clear data processing trajectory. In the days of the mainframe computers (at location or at head office) and data processing departments information was collected at the source, delivered to the data processing department where it was coded, keypunched onto cards and entered and processed on a batch basis. Now most data gathering and entry is done at source on interactive terminals. The most recent development is direct data entry, and at Northern is exemplified by the emergence of automated data logging and recording processes and equipment: the direct 'wanding in' of bar codes on the shop floor for inventory accounting.

3) A third trend is the shift from hardware to software as the engine of technological change, and within the broad category of software the deveolpment of data bases, special information methodologies and management information systems (MIS).

Although particular computer methodologies are developed and applied to specific situations, most share in some combination the package of improvements associated with computer automation: cost improvements, speed, more information and more accurate information. As such, specific computer methodologies are developed and implemented across a wide range of administrative activities. The introduction of EDS (Engineering Documentation System) at London, for instance, improved the accuracy of engineering documents, increased the speed of changes and reduced the labour time associated with the overall process. Prior to the application of EDS, if an engineering code was changed on an assembly drawing, for example, clerical workers would have to search, check and revise all documents with that particular code, not only in the source department but wherever copies of the document were used. Now, in a computerized context, a particular change can be a mass change as one revision cross references revisions throughout the system; management is assured that all documents will have been corrected and that ultimately manufacturing will not be building to the wrong codes or specifications.

MIS is built on the premise that timely and accurate information leads to improved decision making, which in turn means improved manufacturing efficiencies and costs. In addition to improved availability of existing information, MIS also means more information.

With MIS what were formerly hidden events of manufacturing become visible and more production situations, no matter how separate or discrete, become accessible to management. As a result of new information systems every facet of production, from those item by item situations on up to the entire process of production, has become more transparent to management. Production has become more subject to management scrutiny and more responsive to management decisions.

from mainframes with centralized data entry through a stage of remote terminals to the current micros and the emerging computer networks. In plants there have been similar developments. On the one hand is the shift from central to distributed computer control, a trend especially apparent in the continuous process-type operations such as Kingston. Accompanying that development is the shift from computer monitoring to computer control of a production process. A second major development is the growth in computer applications from the programmable control of individual machines to the control over a network, or system, of machines.

While the computer allows for the manipulation of data and things as well as the monitoring and control of production operations processes, telecommunications provides the means for linking the various stages of production together. Communication technologies provide the means for handling the massive flow of information throughout the system, for integrating individual workstations into networks, and for providing the computer-to-computer links with remote locations, such as suppliers or head office. At Northern Telecom current automation efforts are at the convergence of these two base technologies.

The Pace of Change

Technological change at Northern Telecom is both recent and far reaching. The extent of automation at Northern, remarkable in itself, is even more impressive when account is taken of the accelerated pace of change. That pace of change has been swift and its impacts dramatic and ongoing.

The governing technological perspective at Northern is one which describes change as piecemeal and evolutionary; a cautious process of getting one line or operation installed and debugged before determining the next project. The common assessment is this: "Technological change at Northern is an evolutionary, not a revolutionary change." But such an assessment cannot disguise the rapid pace of technological innovation. In the last five years Northern has been in a period of massive technological and organizational change. The momentum that was established in the early eighties is unabated. Everywhere in the organization change has become the new constant. On a tour of one production facility a manager explained, in a tone more than half serious, that on Monday mornings he comes in early to see what has changed over the weekend. At Northern Telecom production lines are reconfigured, offices are moved, operations are shifted around and machinery and equipment is modified or replaced on a frequent basis. As one manager expressed it: "Change is the wave of the future."

Towards CIM

Computer Integrated Manufacturing (CIM) envisions a computer integrated business. As a process it means applying computer-based systems to the integration of design, manufacturing and to the administration and co-ordination functions of management. It means developing computer links between nominally separate activities, such as marketing with engineering and production.

CIM develops along two axes. One has been called horizontal integration — the computerized linking and co-ordination of various production functions in the manufacturing process. The other, called vertical integration, refers to the linking of computer-aided design with manufacturing processes and the development and overall use of computerized management information and planning systems. Northern's CIM strategy has focused on both, although current efforts emphasize the latter. In the early 1980's the push was on FMS or flexible manufacturing systems. Now the push is on the information processing side: As one manager explained it: "The major thrust of CIM is information processing because the labour costs are so low cycle time reduction is the key, so you automate the information processing." While JIT is used to reduce lead times and manufacturing cycles, CIM addresses the demands to reduce the interval between design and manufacturing.

Stages of Automation

There is a three stage process of automation at Northern Telecom. At first new technology is introduced on an application basis. Specific tasks and activities are automated in manufacturing, or in design, or in administration. Historically the efforts to automate different functions correspond to different chapters in the development of the corporation, with earlier mechanization efforts focused on the shop floor and more recent computer automation efforts addressing issues in all three areas — design, manufacturing and administration.

Once various tasks and activities have been automated a

second stage — establishing technological links between different activities — is accomplished. Formerly discrete tasks are integrated as an automated set of activities. In the design area, for example, this could involve connecting CAD terminals to a laser printer thereby linking drafting tasks with copying tasks. In production it could be a robot feeding parts to an injection moulding machine. In administration it could mean the production and transmittal of reports by electronic mail via a computer network.

The third stage involves the technological co-ordination of activities and tasks from different functional areas. Initially the computer links are tentative — an activity from design, for example, is integrated with administration or manufacturing. Over time as technology develops and the company's expertise deepens, more and more links between functional areas are established and then integrated into a unified computer controlled system. This is the state of the business system that Northern refers to as CIM.

The accompanying diagram illustrates how CIM progresses through the computer automation of tasks and activities to the integration of different functions. It presents the stages of automation first along a horizontal axis — task automation and integration automation — and subsequently along a vertical axis — system automation. The lower part of the figure represents the idealized goal of CIM, the state where formerly separate areas are functionally and electronically integrated.

When Northern explains its CIM strategy it focuses on the vertical dimensions of CIM, in particular the computer links between design and manufacturing. Training material describes CIM as:

- utilization of computers to link design with manufacturing;
- integration of computer assisted design with manufacturing operations;
- computer aided design and computer aided manufacturing.

For Northern CIM means 'data driven' production: "ninety-nine percent of the information needed to improve the process," explains one manager, "is already in the product design database that originates with a product at BNR. The role of CIM is to connect that information with the shop floor where it is needed and as it is needed for each specific task."

CIM is not a particular technology but an approach to production. And as an approach it is evolving. One manager expressed it this way:

> "CIM is a complex animal. It is product dependent, location dependent, people dependent . . . The CIM process is dynamic and fluid and as you chart the course for the plant technologically the road ahead is continually changing. CIM is not robotics, not automation — no one specific tool or series of software modules. Rather it is vision of where Northern Telecom wants to be."

THE JIT/CIM CONNECTION

If CIM is an evolving process and a vision of the future then it is one currently strongly influenced by JIT. At Northern a CIM philosophy predates JIT but has since been modified by it. There are two basic differences between JIT production and CIM: One is the approach to automation implied by the model and the other is the role and level of staffing. The early CIM vision was inspired by a view of computer automation as the answer to virtually all production problems — the best solution to a wide range of production issues was assumed to be a technological one. Furthermore, CIM advocates share a utopian view of the possibility of production without people, if not as an immediately accessible goal then at least as the driving force of change. As one Northern manager put it: "When we introduce CIM we get to fully automated lights out factory."

The JIT philosophy, on the other hand, does not rely exclusively on the technological fix. JIT advocates argue that a typical management fault is to over-automate a production situation. As a remedy, JIT introduces the concept of pre-automation, and by so doing it serves as a transition to CIM. Automation — in the JIT sense — is the end of a process that begins by emphasizing simpler plant

configurations and bringing operations closer together, rather than as the immediate goal of the process. Furthermore, according to JIT, regardless of how flexible the equipment actually is in flexible manufacturing, workers remain still more flexible.

Within management ranks at Northern there appears to be some conflict between JIT advocates and CIM proponents. Some managers are unconditional in their assessment: "We're going full speed into CIM." Others are less categorical: "Automation is not necessarily the most effective way to get the benefits." But whatever or however deep the differences, the current approach, and what seems to be a corporate directive, is reconciling the two models. One local manager attempts the reconciliation:

THE TRANSITION TO SOFTWARE

Northern will continue to sell telecommunications equipment and it will continue to develop faster and more reliable transmission and switching products, but in so doing it has shifted its emphasis from digital technology to software control systems. As Northern explains it, there is a value tree in telecommunication products and the goal is to get up the value tree as far as possible. The higher up the value tree the more software-based is the productive activity. In a context of technological transferability, increased competition and a maturing market, product lifecycles have shortened dramatically. One of the means of extending life-cycle is software. Within the industry hardware systems are moving to discrete modules which have multiple uses and are characterized by a rapid schedule of revision. It is the software that confers on the hardware more adaptability and a longer life. According to Northern it is "the key functional differentiation". Northern is committed to software intensive product development. Such a commitment shifts the value-added base of Northern's products from the manufacturing stage upstream to the design stage.

By the 1990's Northern envisions a 50/50 split in its revenues between hardware and software. Software already dominates product development; the typical costs of a new product is split about 80 to 20 in favour of software. Northern's motivation for increased software related-sales is a powerful one. In software sales Northern sees an opportunity to recoup the large expenditures in R&D associated with new product development and to respond to a market thhat has changed rather significantly. The period of rapid growth in the early eighties, which was fueled by the conversion to digital, has ended. Opportunities for Northern's CO and PBX products have about peaked in North America and its former technological leadership in digital switches has been effectively eroded.

In Canada, for instance, Northern projects that the market for telecommunication products will grow about 5% annually, whereas the market for software will achieve close to 30% annual growth rates through 1991. Northern's strategy is now to translate its extensive installed digital base into future revenues. In other words, Northern has to farm its installed base by developing strong service relationships with its customers and by convincing them that new user features and new control features — available with Northern software systems — are the key to improved network control and efficiency and reduced network costs.

Northern's product line strategy appears to be two-fold: 1) to sell more software-intensive products and market what Northern calls "software upgrades for expanded features"; and 2) to introduce entire information technology network packages that include elements of both hardware and software, system control and system operation.

Included in the first category are the new generation of CO switches and PBXs. Northern has been successful in applying technological advances to evolve its systems. The DMS-100, for example, is about half the size it was when first introduced and the range of its features has soared from about 300 to over 1,400. Now with the DMS-Super Node, the latest DMS modification, the system will double the existing call handling capacity of existing switches and promises a five-fold increase by 1990. Similarily, since the SL-1 was introduced in 1975 its software base has increased more than ten times while both the size of the unit and its power consumption have decreased considerably. The new model, the Meridian SL-1ST, offers the same set of voice and data features in a small unit, as few as 30 lines, that were previously available only on larger units.

From the first introduction of digital technology Northern has been committed to the modular design of its switching products. By designing and producing products as modular units Northern has been able to promote product continuity in a rapidly changing environment. The architecture around which its products are built enable modular increases in computing power which has meant that Northern can continue to evolve its systems by offering new features on existing hardware. The first SL-1, for instance, can be upgraded and equipped with the same set of features offered on new models. The transition from hardware to software has meant that feature packages can be introduced separately and it has meant that the software itself can be marketed. In a recent report to shareholders Northern makes the point: "Software upgrades for expanded features, which are easily installed without equipment changes, are provided on a regular basis." Northern has also begun to sell its software as a control overlay — a way for corporations with a private network, or a telco offering centrally-switched services, to more effectively control their operations.

In the late 70's Northern's rallying point was 'digital technology', in the 80's it is 'software networks'.

> "We do not view CIM and JIT as competing philosophies. Others have looked at CIM as representing 'integration' and JIT as 'simplification', with the two often clashing if brought together. At Northern Telecom CIM and JIT are complementary: CIM is a technological message, JIT is an organizational message — 'CIMplification = JIT' — the two work hand in glove at Northern Telecom."

Another makes the point that "with JIT you get solutions to problems on the floor and with CIM you solve information problems, and then you integrate the two."

The shift from CIM-dominated strategies to an emphasis on JIT production techniques, and the current blending of the two, is partially explained by one head office manager as a result of a growing disenchantment with the results of automation: "We were fairly enamoured of CIM in 1984 but by 1985 we realized that the productivity return on our investment was not quite what we had hoped for." There are examples throughout Northern of computer automation applications which are now considered inappropriate. In the line card area at Brampton, for instance, post-wave inspectors recorded defect data on computer terminals but the system was removed because it did not provide quick enough feedback and because the software did not allow for the computation of running totals in a way that was useful for production line operators. At Kingston there is a robotic stacking system on the PIC line. The robot lifts and stacks reels of wire after they have come off the insulator lines and before they are used by the twisters. When the system was installed it made sense and the plan was to extend it. Now some in management wonder if a system that delivered the reels straight from the insulator to the twister without them ending up in a stockpile would not have been more appropriate.

Even where Northern has sophisticated automated assembly systems in place it seems to be the general rule that the automated line does the high volume codes and the manual lines do the shorter runs requiring greater build flexibility. Even the Flexible Manufacturing System at Brampton, no matter how successful, did not meet what some now term the "overly optimistic engineering expectations."

It is clear that JIT has modified CIM at Northern, but the goal of computer integrated manufacturing remains high on Northern's agenda. According to some in management the CIM architecture — the plans on how to get there — is already in place: "The architecture is totally plotted and most of the blocks are in place, or soon will be. It is plotted at the corporate level but implementation is a divisional responsibility."

> "The ultimate vision we are pursuing, of course, is complete Computer-Integrated Manufacturing — the world of CIM that goes beyond CAD, CAM and CAT.
>
> It is a system where product design, materials management, production, and testing are all managed by a single integrated system: a system that can turn in a flash from producing high-quality commodity products to making a specialized, one-of-a-kind system to meet a specific customer's needs."

CHANGES

CIM, FMS, JIT — all are acronyms that speak to changing production techniques. Interval reduction, short cycle manufacturing, Kanban, work cells and flow lines are all expressions that point to revised priorities and changing work configurations. Northern moves fast. Banners and posters — Northern's contribution to the art of corporate surrealism — proclaim the theme of the corporate mission: "The Heat Is On!"

Some of the interim results are impressive:

— At Brampton inventory has been reduced from $150 million to $100 million.

— At London inventory has been chopped to $20 million from $60 million.

— At Belleville CSD inventory levels in 1982 were 120 days. By 1987 it had been reduced to 60 days and the goal for 1989 is 40 days.

— At Kingston inventory has been decreased by 45%.

— At Belleville the lead time for a printed circuit board back in 1984 was 45 days. In 1986 it was only 15 days and the goal for 1987 was to get it down to 5 days.

— At Belleville new product design has beeen shrunk from 38 days to 12 and a half days.

— In Brampton in 1983 there was a 47 week horizon to the delivery date of a system. By 1985 that was shaved to 37 weeks. In 1987 the expectation was 17 weeks.

— In London, back in 1982 there were 37,000 components on the parts list. There is less than half that amount today.

— In Brampton, the wave solder process quality in the line card module has improved dramatically from about 5,000 DPM in 1984 to about 20 DPM in 1987.

It seems that whatever yardstick is employed to measure change, they all indicate that it has been tremendous. In the last five years Northern has set out to transform its production, and in the process of changing production everyone and everything is affected.

CIM COMPONENTS

- **CAD** - COMPUTER AIDED DESIGN
- **CAE** - COMPUTER AIDED ENGINEERING
- **CAM** - COMPUTER AIDED MANUFACTURING
- **FMS** - FLEXIBLE MANUFACTURING SYSTEMS
- **ROB** - ROBOTICS
- **AAS** - AUTOMATED ASSEMBLY SYSTEMS
- **ATE** - AUTOMATED TEST EQUIPMENT
- **AMH** - AUTOMATED MATERIALS HANDLING
- **MIS** - MANAGEMENT INFORMATION SYSTEMS

Northern Telecom CIT/CIC Training Manual

COMPUTER TECHNOLOGY IN DESIGN: COMPUTER AIDED DESIGN (CAD)

A CAD system is an integrated and expandable package of hardware, firmware and software. At the hardware level it consists of basically three sets of equipment: the central processing unit; a workstation, composed of a keyboard, 'menu tablets' and a colour monitor; and a plotter which prints hard copy of drawings or else generates tapes of numerical co-ordinates. The firmware is essentially the add-on memory boards used to expand the system's storage capacity (ie. the creation of a library of past designs, parts, components etc.) and processing power. The software is the basic computer operating system plus a programmed package that allows mathematical calculations and graphic representations (lines, circles, arcs, mirror-images and 3-D models) to be made.

At Northern expanding the CAD system has meant making it faster and more powerful through the purchase of additional memory and more rapid computing and processing. It has also meant 'updating' the system to include and incorporate new features such as the introduction of CAM (manufacturing) links through DNC (Direct Numeric Control) tape encoding, as well as new developments such as E-CAD (electronic CAD) and 3-D CAD.

In Northern the CAD system really consists of three systems with somewhat functional specialization. There are the M-CAD operations, the E-CAD operations and the CAD/CAM operations.

Mechanical CAD

Mechanical CAD has automated tasks and activities formerly performed by designers, drafters, and technical and clerical support workers. It is used to a degree in new product design (telephone wall jacks at London or shelf configuration in the DMS switches at Brampton) but in the manufacturing locations it is primarily applied to manufacturing support functions such as the design of tools, fixtures and some test sets. In its more pedestrian functions M-CAD is an electronic drawing board, the equivalent of a drafting 'wordprocessor'. It has automated drawing and, perhaps more importantly, it has streamlined the editing of drawings, whether they are parts, plans or blueprints.

A CAD system has a number of particular capabilities that enhance the productivity of designers and drafters. Working at the keyboard an operator can take specific features of a design and copy them to other areas of the design, a function which eliminates much repetitive drawing. Sections of the design can be moved around, the screen and images can be rotated to present different angles and perspectives. The system can change the scale or proportions of part of the design or the entire design, it can 'zoom in' and 'explode' parts of the design to clearly show assembly procedures, for instance, and it can perform fit and tolerance checks on designs. In addition, once a drawing has been completed it can be stored in a design library or data base which is readily accessible in subsequent design efforts. At Brampton the design library already consists of about 3000 drawings and there are about 3500 to 4000 changes made to drawings each year.

Electronic CAD

Whereas M-CAD is used to design products, tools, gauges, test sets and fixtures, E-CAD is used to design and draw the complex circuitry of printed circuit boards. The software used to design the boards was developed by BNR, and BNR maintains an updated data base of parts and components used in the printed circuit boards. At Belleville and Brampton the E-CAD operations are distinct from the M-CAD operations and the staff are associated exclusively with one or the other system. In Belleville, the E-CAD system is on line to BNR and there are electronic links with the Northern operations in Santa Clara, California. Similarly, Brampton is on line to BNR and there are electronic links with the Belleville Bridge St. board production operation.

CAD/CAM

The application of CAD at Northern demonstrates the various stages of technological development: the automation of specific tasks and activities; the computer linking of different sets of activities; and finally, the integration of previously distinct functional areas. The power of CAD rests specifically in its integrative capacity, or at least its potential to integrate diverse production functions.

In automating design functions CAD makes it possible to integrate functionally separate operations. At the same time that a new product, tool, or circuit board is being designed, the build instructions — including the required equipment, tools, raw materials and production steps for the item — can be generated. If the build instructions are automatically transmitted to the manufacturing equipment then in addition to computer design there is computer assisted manufacturing. The acronym CAD/CAM refers specifically to this linking of design activities with actual manufacturing operations.

At present the push at Northern is to achieve the computer integration of design and manufacturing. Once a product has been designed on CAD it is possible to automatically generate a program that will control automated equipment. Furthermore CAD processing capability could, in turn, be used to generate a parts list, bills of materials and product descriptions which could be electronically transmitted to the relevant administration departments thereby representing yet another functional link. These efforts are currently on the engineering agenda. CAD is one of the technologies which collapses organizational and procedural distances.

CHAPTER THREE:

TECHNOLOGICAL CHANGE AND JOB CHANGES

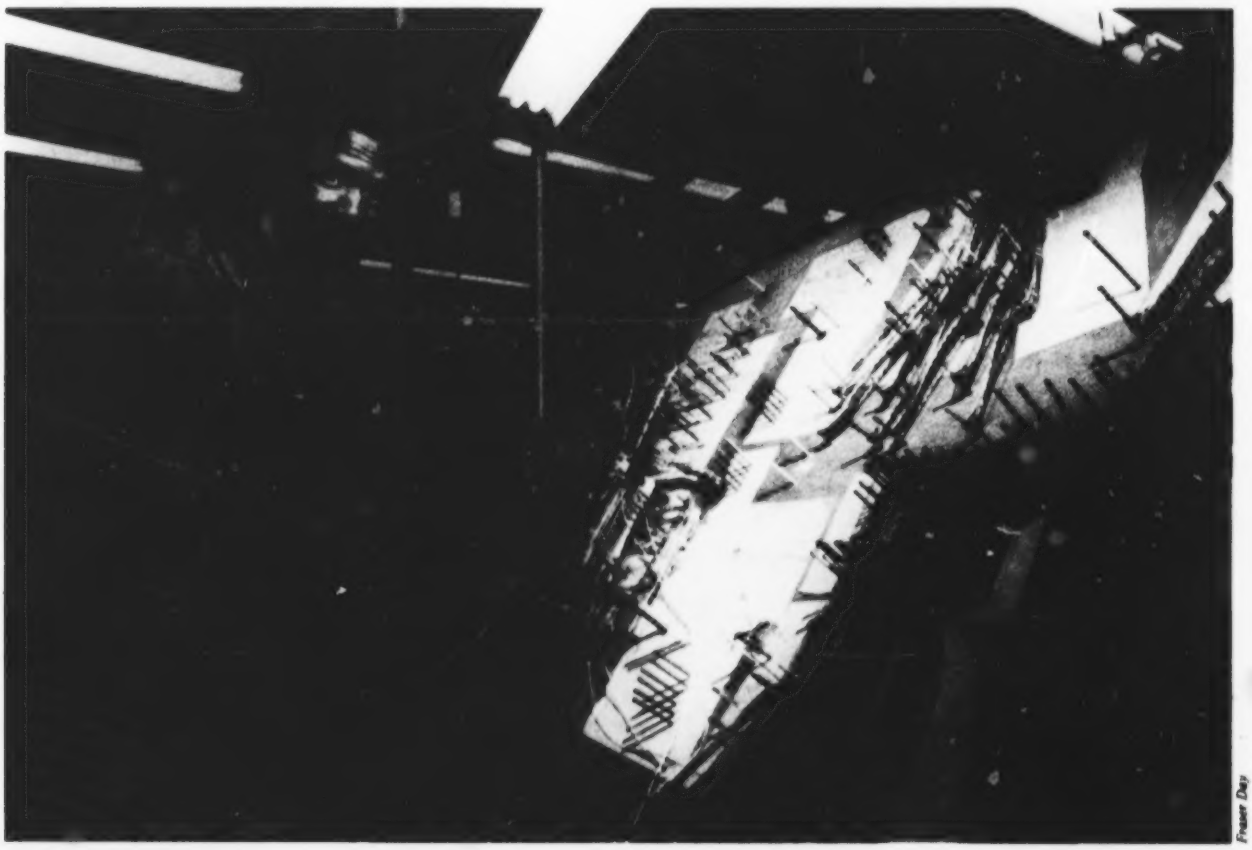
Technological change means more than updating the equipment. Computer automation specifically, and technological change more generally, generate new demands on workers and substantively change the what, how and where of peoples' jobs. The changes are extensive: The flow of work is changed, relations are altered, standards of work performance and measurement are redefined, work tasks and job duties are modified, new skills are demanded and existing skills are made obsolete. In addition, concepts of responsibility, control, pace, autonomy, stress, supervision, are all affected.

In automated workplaces the change in jobs is not exclusively in one direction, either for better or for worse. Instead there is a polarisation of effects. The changes associated with new technology at Northern have led to skilled and complex automated work and to unskilled, repetitive and fragmented jobs.

In this chapter the impact of technological change is explored by focusing on selected jobs and a range of corresponding issues in the three work situations of Northern Telecom — in the plants, the design departments and in the offices.

In examining the effects of technological and organizational change in the plants the focus is on set-up jobs, process control jobs, circuit-pack assembly, testers and the skilled trades.

In the design departments the attention is on CAD jobs. And in the office a range of clerical jobs.



Fraser Day

A DECADE OF CHANGE: PROFILE AND PRODUCTS

The year 1976 was a milestone in Northern's history. It was the year the company changed its name from Northern Electric to Northern Telecom, a prescient choice given the changes that were to come. Northern Telecom. It was a name that recognized the changing technological base of Northern's products and one that announced the course of Northern's next decade of development. Telecommunications and the rapidly changing field of electronics was shifting the ground from telephony and the mature techniques of electrics. The coming decade would dramatically transform Northern. Every aspect of the company — its products, its processes, its markets, its geographic centre, its workforce — would be caught up in the sweeping changes associated with the transition from Northern Electric to Northern Telecom.

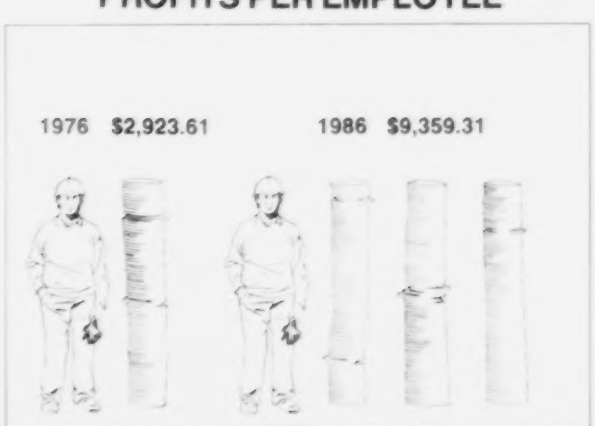
The year 1976 was more than a symbolic banner-year. It was the first year in the company's history that the 'billion' dollar revenue mark was reached. It had taken Northern Electric 93 years to reach the sales threshold of one billion dollars. It would take Northern Telecom only the next four years to double it. From there on it was easy. Another two years added a third billion and four years later, by 1986, that record had been doubled once again. In the period from 1976 to 1986 Northern's revenues soared from $1 billion (Cdn.) to $6 billion and its profits more than quadrupled from about $74 million to over $432 million.

The year 1976 also marked a technological watershed. It was the year that Northern announced a full line of completely digital central office switching equipment, marketed under the concept of 'Digital World'. Digital World products such as the DMS series of switches substituted semi-conductors and integrated circuits (ICs) for the electro-mechanical devices in previous generations of switches. Digital World was the successful application of computer technology to telecommunications needs. By the late seventies over 70% of Northern's business was in products which did not even exist six years prior. Similarly, the products of the late eighties will account for only 40% on Northern's market sales by 1991.

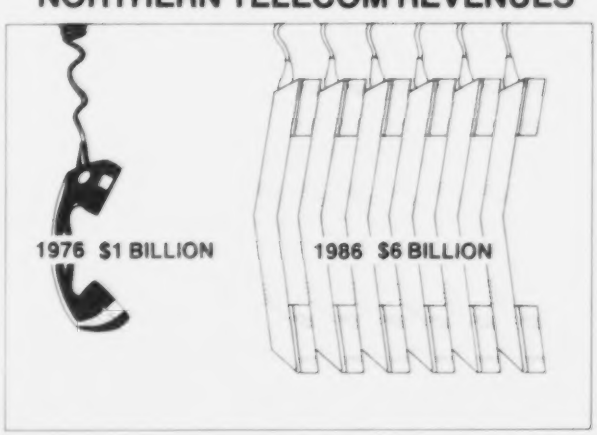
The year 1976 was also a signpost to Northern's shifting geographic reference, a move in the corporate centre, if not an actual notice of a change of address. In 1976 U.S. sales accounted for less than one third of the company's total with Canadian sales contributing over two thirds of the total. By 1986 the pattern had been reversed with the US accounting for 65% while Canada's share of total customer revenues had dropped to 30%.

Finally, the year 1976 was a bellwether of the changes in employment patterns, skill demands and the composition of Northern's workforce associated with a company migrating from 'old' to 'new' technology. The Brampton plant reflects those changes. The workforce, which had once peaked at 4,000, was by 1978 reduced to 2,400. In 1987 the figure was about 1800. By the late seventies Northern had established an employment pattern of shedding its traditional blue collar workforce. In the future employment growth would result from expansions and acquisitions and would be sourced primarily in the United States.

PROFITS PER EMPLOYEE



NORTHERN TELECOM REVENUES



CORPORATE ORGANIZATION

There are two pivotal legal and organizational relationships which have shaped Northern Telecom. One is the parent-subsidiary ties between Northern and Bell Canada Enterprises (BCE). The other is the joint ownership links between Northern and Bell Canada Enterprises and the subsidiary, Bell Northern Research (BNR).

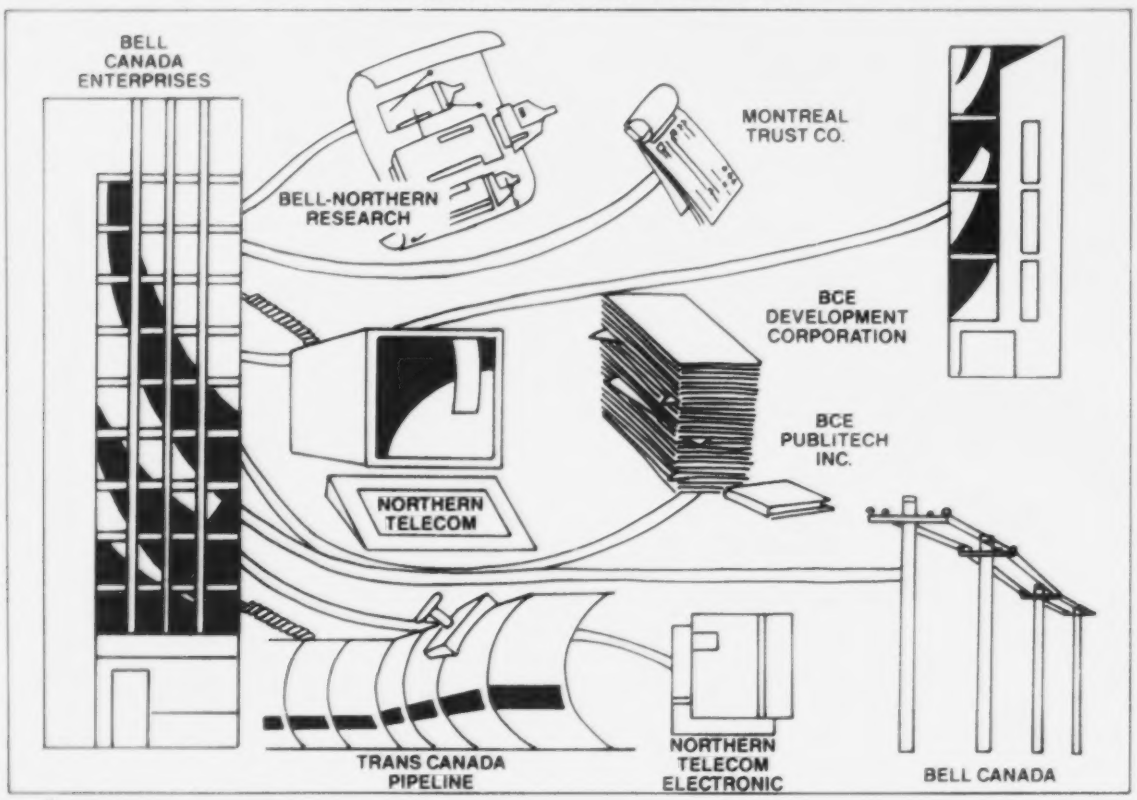
Northern's corporate pedigree is blue chip all the way. It is by far the largest telecommunications company in the country and it is the country's largest producer of plastic products. Its subsidiary, BNR, is the biggest private industrial research and development organization in Canada. Another subsidiary, Northern Telecom Electronics, is the number one domestic chip manufacturer. Its parent company, BCE, is the largest conglomerate in the country, made up of over 150 companies in telecommunications, energy, real estate, printing and publishing. Bell Canada Enterprises is the premiere profit-taker in the country and the only company in Canadian history to break the $1 billion profit barrier. BCE surpassed the billion dollar profit mark in 1985 and again in 1986 — an accomplishment described by *The Report on Business* as "awesome".

Among the BCE holdings is Bell Canada, the largest telephone utility in the country and the major contributor to the BCE bottom line — two-thirds of BCE profits are attributable to Bell Canada. Also included is TransCanada Pipelines, the biggest gas pipeline in the country and BCE Development, formerly Daon, one of the top five real estate developers and the company, coincidentally, responsible for the construction of Northern's new head office in Mississauga.

Northern is number one in Canada, number two in North America and it occupies the fourth spot on a world scale of leading telecommunication firms. It has a stable of over 40 finance, sales, manufacturing, holding and associate companies worldwide.

Northern is in the process of positioning itself for its next decade. By its own admission it wants to be Number One by the year 2000. It is now shaping the policies, designing the products, and putting in place the production techniques that it hopes will achieve its ambitious objective.

CORPORATE ORGANIZATION



I. IN THE PLANTS

The opposing outcomes of technological change in Northern plants can be illustrated by comparing the jobs of those on the new automated lines with those who work on the slide lines. The range of issues associated with new technology can be illustrated within job groupings by focusing on skilled trade and testing jobs.

POST-TAYLORISM OR SUPER-TAYLORISM?

Automated Jobs

Northern's new automated jobs can be grouped in two broad classes. One includes the set-up operators/co-ordinators of the new automated lines like FMDC, PCP and Line Cards. The other includes the process control workers on the continuous or near continuous processing lines in Belleville Bridge St. and the Kingston insulator lines.

Set-Up Jobs

The application of computer-based manufacturing technologies has produced a new type of automated job different from traditional machine or set-up jobs. These jobs can be seen on the Printed Circuit Pack line at London or the Flexible Manufacturing Centre at Brampton.

Excerpts from job descriptions highlight the changing job requirements of automation workers and the emphasis management has placed on analysis and troubleshooting functions. High on the list are the requirements to "analyse breakdowns", to "identify and analyze process problems" and to perform "basic trouble shooting". The new automation jobs require good communication skills, basic computer skills and "a high degree of analytical capability."

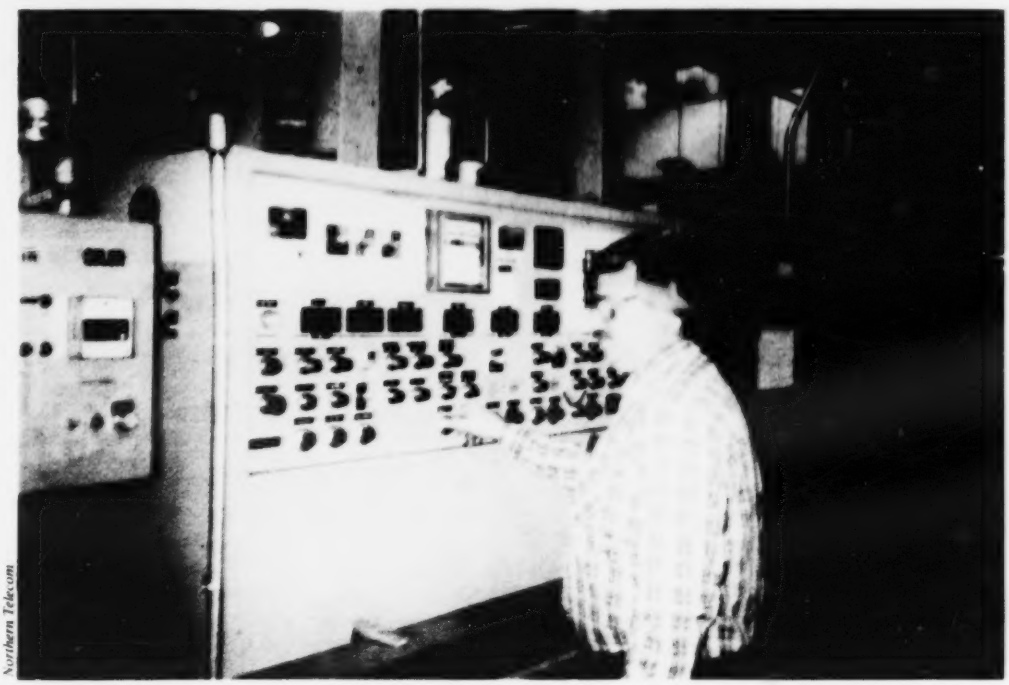
They involve more monitoring of processes and machine functions. The jobs are considered by those who occupy them as requiring higher skills. One worker concludes that: "Technology has increased your skill. You have to know much more about the product and the machines." Others concur and one points to the new computer languages:

> "The robotics side is basically babysitting but you have to know a lot, and you have to know it! We've got three different languages to learn. It takes a long time to learn the amount of material we have to learn."

In the new automated jobs the time spent at work ranges from periods of attentive inactivity to periods of stressful demands. And although the jobs are defined more in terms of monitoring than doing, the lessons of automation — "the machines are never going to run right" — suggest that there is still much in the way of 'doing' in the jobs, from loading feeder bins to tweaking the system.

Process Control Jobs

In Northern a second type of new automation job can be found on the wiring lines at Kingston. As the capability of computer applications develop from process monitoring to process control, workers are required to make the reverse transition from process control to process monitoring. According to one manager insulator line operators in Kingston "used to monitor the product paramaters. Now they require the capability and ability to monitor process parameters." The workers on the newer lines no longer 'twiddle the knobs'. Instead their skills have shifted from "manual to abstract understanding." He says workers have "got to understand the process; why things happen, what they do."



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The new lines are more productive, but as another manager explains, that productivity has a price. At times there are "unexplained downtimes with high tech lines. Something changes and we don't know what it is." Workers, speaking on the same matter, refer to the lines as having "quirks". In any event, downtime is costly, mistakes are critical and workers are under a lot of pressure.

Kingston management is consciously trying to forge a new generation of insulator operators. It has launched its training initiative with a course directed at new insulator operators. The course emphasizes the "unseen process". One manager explained that training is essential because "things are more technical than in the past" and because work requirements are changing: "There is more troubleshooting, more use of process charts (because) a lot of things an operator can do can screw things up."

When managers speak of the new technology production worker the above jobs are typically what they have in mind. The first group is distinguished by the increasing demands to analyze and troubleshoot; the second by increasing demands to understand some of the laws of the process. In both cases there is a move away from the traditional definition of filled worktime and measureable activity. And in both cases there is an attempt to forge new worker attitudes and behaviours. In these jobs can be found the emerging new set of skills and attributes that have come to characterize new technology jobs.

- good communication skills
- basic literacy and numeracy
- statistical inference, the meaning of data, trends, limits
- attentiveness
- understanding the basics of computers
- understanding of process phenomena
- conceptual thinking and visualization
- individual responsibility and initiative
- diagnostic and problem solving skills
- functional interdependence

Repetitive Assembly Jobs

It is instructive to compare the brief profiles of the new automated jobs with another set of jobs at Northern, those involved in repetitive assembly.

Assembly jobs in Northern fall into a number of broad job families which differ from each other in terms of grade structures, skills, responsibilities and their relationship to new technology. Some assembly jobs remain relatively unaffected by technological change because computer automation has not yet been applied (but will be), and others because the tasks are not easy to automate or else the automation cannot be justified in terms of cost, flexibility or efficiency.

Those jobs which are affected by technological change but which have not been eliminated typically conform to three categories. One group are semi-automated assembly jobs, such as operators of Royonics machines. A second are jobs which are ancillary to automation and where assemblers are required to do what the automation fails to do. A third are jobs where workers fill the gap left by the automation. Technology is not only what is automated but what is left over.

The greatest change in repetitive assembly jobs in Northern has resulted from the introduction of slide lines for circuit pack assembly.

Circuit Pack Assembly Jobs

Northern has opted for a combination of automated and manual assembly techniques in the assembly of printed circuit packs. In manual assembly the most prominent procedural innovation — and one that is shared by London, Brampton and Belleville — is the slide line.

Slide lines are manual assembly lines characterized by the serial and progressive build-up of printed circuit packs. Instead of one assembler building the board from start to finish as it used to be done, each worker does only a small number of tasks repeatedly. (Slide lines are what Just-In-Time advocates refer to as pre-automation — they break complex jobs into constituent tasks, standardize activity, shorten distances (flow and reach), properly position parts and tools and then decide what automation, if any, makes sense).

The lines are set up in parallel groups of two with up to eight workstations on each side. One worker describes the physical layout:

> "The lines are front to front. I'm two feet from this guy, two feet from the other guy, I've got three people sitting across from me. I can't put my feet out or I'll be kicking the person across from me. It is just a mess."

The jobs are fairly straight-forward and assemblers are typically graded at the low end of the grade structure. The job involves inserting integrated circuits (IC's), capacitors, or other electronic components into a circuit board, soldering some parts or leads and then sliding the board over to the next person who does something similar. An inspector at the end of the line (if there is one) looks for missing parts or bent leads on each board.

Management describes the advantages of the slide line in terms of productivity, flexibility and a more involved workforce. A group of assemblers on a slide line can produce a high volume of circuit packs quickly. Its flexibility is derived from the ability to vary the number of people on a line and the number of lines depending on the complexity and quantity of the pack being built. But management goes so far as to describe slide line jobs in terms of enlargement and enrichment. As one senior manager expressed it: "We're not hiring people from the neck down anymore. People are thinking. They're involved in the process." Management argues that on the slide line people are more involved in the process and have more control over production. The point is stressed in terms of in-line inspection:

> "We're trying to develop in-line inspection so the operator is looking at more than their own work, at quality, doing more on the job. It increases the variety of tasks. It's not just simple work, it's more than just sticking components on a board."

Workers, however, describe their jobs in considerably different terms:

> "They are taking away pride in the job. How can you have pride in the job when you put the same six parts in eight hours a day. You are not even thinking about what you are doing. You're a human robot. I don't even think about what I'm doing any more."

Workers sit at their station for the entire day — work is brought to them; they only get up to go to the washroom or at break. The workstations are cramped — people work elbow to elbow, and if the line opposite is running there is not enough room for workers to stretch their legs without bumping the person opposite them. The production quotas set by management are typically unattainable and a common complaint is against a management which tries "to play competition between shifts."

Slide line workers are critical of the lack of control they have over their jobs. Even in situations where managers have allowed the operators to rotate between work stations some assemblers argue that the slide lines have made a bad joke out of concepts like job rotation:

> "We can rotate on the slide line. Instead of putting six capacitators in we can now put six resistors in. Big deal. Don't tell me that that is going to make peoples' jobs more interesting. It sure as hell isn't."

Instead of feeling more control over the process, workers feel they are kept out of the process. One worker explains:

> "You don't have to know what is going in, you just have to know where to put it. We are not allowed to know what we are doing."

Much of the hostility toward jobs on the slide line stems from people's experience with the jobs they replaced. At one time circuit packs were built individually by each operator on a bench. With the introduction of slide lines circuit pack assembly jobs were deskilled and some were downgraded.

In addition to the pride, responsibility and autonomy of the bench jobs, the old jobs meant more mobility:

> "The grade 4 power board assembly job used to be one of the best areas in the plant to work in. You pretty well built the board from scratch, and if you had the seniority for posting the analysis number would get you into most other areas in case of a surplus. It used to be a separate job and it was a great job, and of course they came and took that away from us."

Among those workers the verdict is unequivocal:

> "The slide line is a boring job. People don't have pride in their work anymore. They call it the 'slime line'."

TECHNOLOGICAL CHANGE: FOR BETTER OR WORSE?

New jobs and job packages are created in situations of technological change. They can be jobs like the new automated jobs associated with set-up and process control or else they can be jobs like those on the slide line. But the impact of technology is not restricted to these new job categories because existing jobs are also changed. The extent of the changes and the reactions to them can be seen in the jobs of skilled trades and testers.

Skilled Trade Jobs

The growth in the quantity of the equipment, the greater variety in machinery, the increasing sophistication of each machine and the ongoing effort to network the entire system all have an impact on the skilled trades. Northern plants are becoming increasingly complex and the new production systems change the jobs of the skilled trades

and highlight the issues of training, demarcations, deskilling and shift changes.

> "Our job has changed a lot over the past few years with the introduction of robots. Before the equipment used to have 1000 transistors in it and you could figure out what it was doing by looking at the schematics. Now with computer chips you don't know what's in the chips. It's memory work. You have to know what each chip does."

> "You have to know more about what you're doing. On some of the machinery it all ties together, your electronics in the computer and your mechanical stuff, so you have a problem figuring out what causes the machines to do certain things."

Training

The shift to digital logic control in much of the new equipment focuses both management and worker attention on training. Management's goal is to have the necessary skills to work with the new technology. For workers the issues are access, distribution and the limits imposed on training by management. The inadequacy of training programs is a major complaint of skilled trade workers:

> "There isn't adequate training. One day there's a machine there and the next day you're fixing it and you wonder where it came from."

The concerns skilled trade workers have with the available training arise from limited access and the preferential treatment given engineers.

> "Training for the maintenance staff, compared to what the engineers get, isn't there. They get more training on the new machines that come in and we're the people who have to fix them."

> "They (the engineers) make sure they get all the good training, we're always stuck sucking the hind tit. Then we get stuck on the third shift."

Computer technology has emphasized electronics as a growing skill requirement. The need for electronics is not disputed by skilled trades. At issue is how Northern has achieved the new skill. In London and Belleville management has demonstrated a preference for hiring the skills rather than training for them. For instance, while machine repair or industrial mechanics handle all mechanical faults on the new equipment, electronic technicians, graduates of a 3 year technical school course in electronics, diagnose and repair all computer and electronic faults.

Demarcations

Management uses technological change to restructure the content of jobs. In the skilled trades this takes the form of collapsed classifications or brand new categories. In Brampton, for example, the company has created a new job classification of electronic technician which crosses the demarcation lines between electrician and machine repair functions. This new group was given exclusive rights to the job of repairing and maintaining all automated equipment in the line card and FMDC areas of the plant. Basic trades are only allowed in for major rebuild work, and there is some dispute over who is in fact doing that work as well. The technician jobs were filled by junior people who responded to the carrot of training on the new technology.

The creation of special jobs and protected enclaves has threatened seniority rights and led to the emergence of new divisions within the workforce:

> "The company has said that the basic trades won't be able to bump into this department in the event of a downturn even though the technicians are the most junior people in the plant. And their argument is that the basic trades haven't got the training to do the job."

Deskilling

While the application of computer based automation imposes new skill requirements it can also degrade the skill content of work. In the trades deskilling gets expressed in two particular ways. The first can be illustrated in the introduction of CNC machining centers. According to skilled trade workers, CNCs degrade the skill content of work and actually threaten the jobs of toolmakers and machinists. As one toolmaker predicted:

> "If you have perfect programming then operating the equipment, which essentially is all we are, is not a fundamental procedure. You just 'begin' and 'end' and the job is finished. When they get past that obstacle they'll be able to take somebody out of school with no basic skills and train them to be a button pusher."

A second source of downward pressure on the skill of workers can be seen in the diagnostic and troubleshooting capability of the new computer technology. At Northern

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machine repair/mechanical trades, electronic technicans and test set repair workers are all affected by these developments. One worker makes the case:

> "The troubleshooting is all done for you by the computer and shows up on the screen. It tells you such and such a part is down so change the part."

The electronic foundation of the new automation often means that repair work is reduced to replacing a faulty circuit board with a new one and throwing the old one away. As one test set repairman put it: "A lot of work is down to board swapping. Pull the board and send it back." His statement is echoed by tradesmen as well: "They don't want tradesmen, they want part changers."

Shift Change

More equipment and more complex equipment means an increased work load for the trades and it can mean a change in the hours of work. With the pressures of production and the high cost of idle time on the new automated equipment, nights are often the only time set aside for preventative maintenance. In London management has already indicated its desire to carry out PMs on the new equipment by adding a midnight shift. As one trades worker reported: "We don't have a shift like that in the collective agreement. It's all because of the automation."

Testing Jobs

Electronics and software driven systems together with the methodological innovations associated with cellular manufacturing have changed testing jobs. The results are uneven. Some testers are challenged with harder but more interesting work while others are threatened by the prospects of deskilling, insecurity and barriers to mobility.

On the upside the switch to electronic products and processes is associated with different skills and new job requirements. Excerpts from a troubleshooter's job description provides some indication of the new skills:

> "(The tester) will be required to perform analysis of devices in and out of circuit . . . Issue reports to component engineering for evaluation. Will be required to acquire data from available on-line computers and other sources to provide statistical analysis to Component Engineering. Will be responsible for set-up, programming and trouble-shooting computer controlled test equipment . . ."

On the downside, technology has been used to simplify the content and automate the functions of testing. One manager was frank in his assessment:

> "We want to reduce tests to their lowest common denominator. It increases our control and our flexibility with labour. It's much easier to find lower skilled people."

The deskilling of testing work is captured in the following remarks of one worker:

> "At one time testing those boards was a much more complicated job. You had to do more thinking on your own. Now you just have to push a few buttons and that's it. The test set does it. Either it's good or it's bad and it tells you where it's bad if it is bad, so you hand it to the repair operator and they repair it . . . they've deskilled the job, machines are doing it."

Computer Simplification and Redistributed Work

There appears to be a double-sided trend among Northern testing jobs. Lower graded jobs working with the new equipment have absorbed higher graded functions and higher graded jobs are being forced to absorb the functions of lower graded jobs. Northern's manufacturing strategy hinges on the application of new equipment and the use of information to bring the process of production under greater management control. A first step toward this goal is simplification and simplifying production requires an understanding of the tests and processes to be simplified. One worker describes the dynamic of the process in the following way:

> "(The company) want to learn everything that is going on. In one area you have your grade 7 and your grade 9 testers who are right out of school. They want to do a good job, so the company gets them to document every little error and every little problem. They make a history of it and then all of the sudden you don't need those grade 7 and grade 9 testers because the history is there so a grade 2 can do it."

In other situations the trend is to the elimination of lower grades. Many grade 5 testing jobs have been eliminated at Northern. But the loss of grade 5 testing jobs has not meant that all grade 5 testing functions have been eliminated. Instead, those functions are being shifted onto higher graded testers. In Brampton one worker described the change in this way:

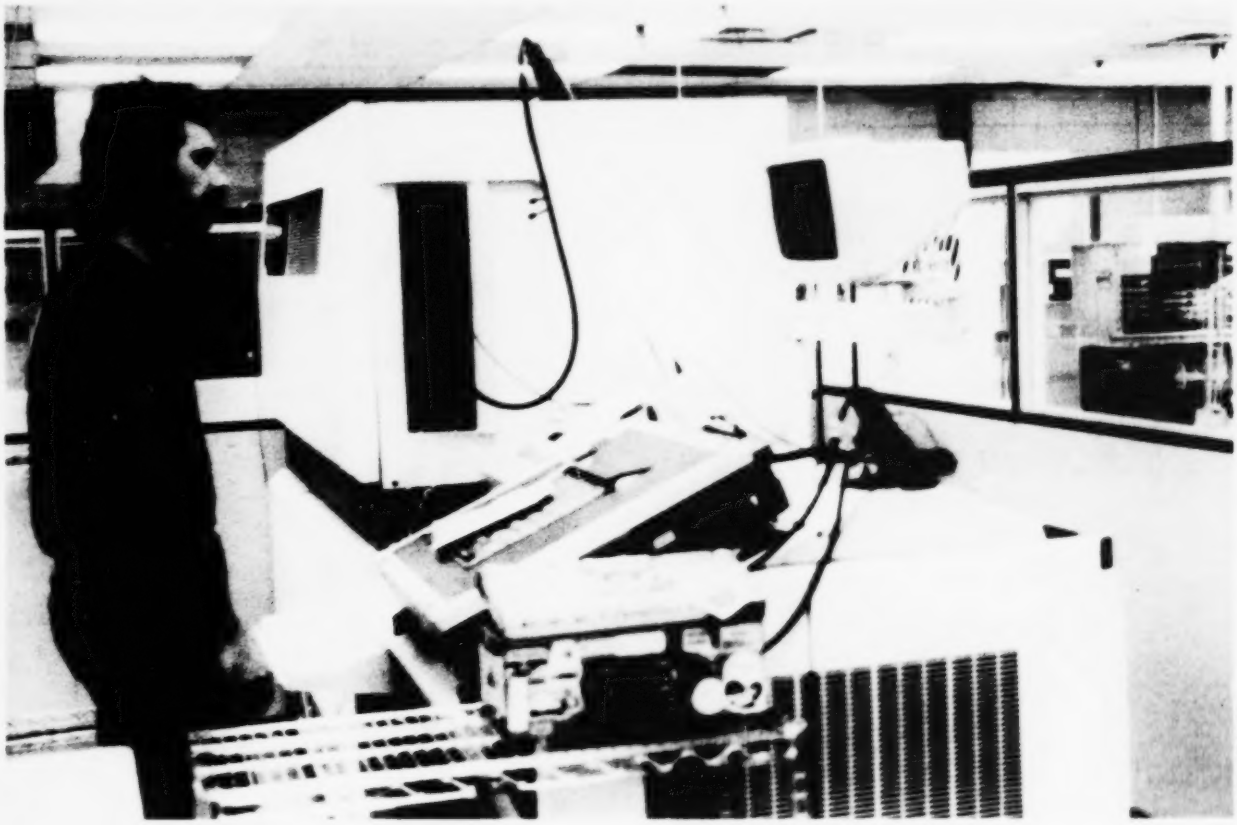
> "Management wants higher graded testers in the area. In the recent surplus only grade 5 testers were surplused, not grade 7 or 9. They're going to be doing these lower graded functions."

Mobility and Credentialism

The elimination of lower graded tester jobs together with a growing credentialism have effectively restricted the movement of production workers into testing jobs and have put higher grade jobs out of the reach of lower graded testers. According to one worker:

> "Lower graded production people have traditionally gone back to school and then moved across into grade 5 testing jobs. But if the company is going to set the jobs at the grade 7 or grade 9 level we'll never be able to move across into testing."

Management at Brampton requires testers to pass competency tests in order to operate each particular test set. Many testers, however, feel the qualifications being demanded by management for certain testing jobs are artificial. According to one tester:



"Some of the tests are crazy. You write the test and you need three years of university to pass, and then you get on the floor and wonder what the hell the test was all about."

While it restricts opportunities for lower graded workers, credentialism has another effect. It means that junior testers with post-secondary degrees are being protected in layoff situations, or offered other jobs, while more senior testers are let go:

"So they're offering employment to junior people because of their higher skills and the people who have accumulated service — like grade 5 testers whose work hasn't gone, it's just that somebody else is doing it — are out on the street."

"There is a lot of stress associated with the technology, especially for testers who are threatened with layoff. They feel they've studied, paid for courses and the company doesn't care, they're keeping the junior people."

II. IN THE DESIGN OFFICES

In the design and technical offices the broad features of the issues surrounding technological change are similar to those found in the plant. High on the list are concerns over skill and training, opportunity and security. Northern technical workers are involved in product development, tooling engineering and laboratory operations. Their work includes data collection and analysis, chart and report generation, interpreting design sets and determining component configurations. They work in quality engineering, manufacturing engineering, technology and other technical departments and they work with a variety of computer-based equipment. But if there is a single technology that occupies a pivotal position in Northern's value-added strategy, it is Computer Aided Design (CAD).

CAD Jobs

How people react to new technology is influenced by many factors, including the backgrounds and personalities of the operators and the attitudes and behaviour of their managers. But even taking into account individual characteristics and responses it is still possible to outline some common issues among CAD operators. Operators readily acknowledge and appreciate the productivity increases associated with CAD, and those who formerly drafted "can't imagine going back to the board." At the same time they deplore the threat to jobs and the potential CAD represents to shift work outside the bargaining unit. In developing a common skill base between drafting, designing and engineering, CAD has nurtured a conflict between technicians and engineers over CAD work. One CAD operator called it an "us against them syndrome".

Skill

Those who have made the transition from drafting to CAD believe the shift has, on the whole, increased their skill. One worker described it as adding a new dimension because he is now engaged in "computing as well as drafting." Others talk about their work being more creative.

Former draftspersons believe that, as a prerequisite to working with CAD, operators should know drafting. In this perspective is the recognition that, since CAD does not require a background in drafting, it renders obsolete a set of skills workers have and consider important. The same holds true for toolmakers who are now designing on CAD or operators programming tapes for computer controlled machinery. One operator explains:

> "There is a difference between theory and practice. Someone with tool design experience is better than someone with CAD alone. Community college is not a substitute for tool design experience."

Stress

While CAD operators agree that CAD makes tasks easier, activities less repetitive and jobs more responsible and more interesting, they are critical of the price they have had to pay for those benefits. CAD operators work in stressful situations. The stress gets expressed in different ways and is attributed to a number of sources — the technology itself, general working conditions and, more often than not, some combination of the two. Although CAD requires the operator to "think faster because the system takes you through it a lot faster", the stress is not so much a product of the mental demands as it is the frustration associated with the limitations of the technology, how prone the system is to mistakes and how management relates to the system:

> "The thing with a CNC program is that you think it's doing something, you're watching it on the screen and then you go down to the machine and all of a sudden it doesn't do what you think it will. But you don't see it on the screen. There are these little glitches, there are problems with the software. They fix some bugs but then they get bigger bugs. It really gets frustrating. At times you feel like taking a lead weight and throwing it through the screen."

> "All you have to do is hit the wrong key and think you are doing it right and then at the end it's 'Oh my God, what did I do wrong? Why isn't this working?' On the (drafting) board you don't have that problem because you can see it."

CAD operators talk about getting caught up in the technology and they point to what happens as a result. One worker described how "you get in the groove . . . you just keep going . . . you don't want to have to go home and then come back and try to get into it again." Another worker explained how you "tend to forget the clock and just keep working."

> "You sit there all day long and your mind is going around and around and at the end of the day you walk out and your mind is still going . . . Sometimes you just can't shut off your mind."

> "One day I was so marble jarbled that I got into my car and left and my wife was still in the parking lot waiting. I had gone about two miles before I realized it and had to turn around and go back to get her."

CAD operators attribute much of their dissatisfaction and frustration to management, either because of what they perceive as unrealistic expectations or unreasonable time pressures:

> "Management takes a look at these textbook examples and they figure that a guy can do a design in two weeks — puff, puff, poof and it is done. It's

ELECTRONIC TECHNICIANS

The decline in the number of technicans at Northern is leading to an intensification of work for those who remain. For one technician it means that: "I've got a stack of work that I haven't looked at for six months. I just haven't had time to look at it." In addition to working harder Northern technicians are finding their mobility restricted. At each location the refrain is similar: "It's getting harder and harder to get an upgrade."

For some technicians restricted mobility results from 'capped jobs' — where management defines jobs in certain areas at a relatively low point on the grade scale and limits movement out of those jobs. In other cases the brake is applied by arbitrary management judgements:

> "They look at the grade structure, not at your individual performance, to determine if you get an upgrade or not. You could be doing two other people's jobs."

TRAINING

Northern technicians are critical of the training they receive and don't receive. The concerns range from restricted information and limited access on new systems to concerns over the distribution of training. As one technician said: "The system, my major tool, would be much more beneficial if I could massage it the way I need the information." Another accounted for the difference in ET and engineering training as follows: "I think there is a reluctance to train the union types, to put it bluntly and honestly."

Another worker explained the limits on training in the following manner:

> "One manager said an ET is only good for five years. When the person graduates out of school he has the latest and the greatest available to him and over the first five years he is an asset to the company and at the end of five years why retrain him? Hire the new guy, he has got the fresh stuff."

Tom McKenna

really frustrating when you get on there and it doesn't do the things that you want it to do."

"The time demands are so high, we're always under pressure to shorten lead time."

"No matter what happens the deadlines don't move."

"Management lives in a sort of Utopia. They see only what they want to see. They think it is a piece of cake — there are no problems and in a few hours its done. They don't realize that it takes a hell of a lot more time and that sometimes things happen that shouldn't. It's frustrating."

Stress is also associated with management's refusal to acknowledge that stress even exists. One worker explains:

"According to the manager there is no stress because he says it is a proven fact that there is no stress level from working on terminals."

Some CAD operators complain of the physical symptoms that are commonly associated with VDT's, what one worker calls 'terminal life' — the headaches, sore eyes, blurred vision and mental fatigue:

"When you are working away sometimes and concentrating you are an inch away from the machine and you're working. You're looking at the screen and then all of a sudden your mind goes — as if somebody shut off the switch — it goes clunk! It just stops and you go into a pause mode. Then you have to get up, walk away from the machine and then come back later."

"It's almost as if your equilibrium has gone off. You stand up and your eyes don't function properly."

"Your eyes bother you after a while and your mind sort of goes squirley."

At Northern there does not appear to be much attention paid to the general physical environment or the particular ergonomic features of CAD systems. Although it varies with location there are complaints about the lighting, the chairs, the temperature, the noise and the air quality in CAD quarters. In one CAD area, while hundreds and thousands of dollars had been spent on hardware and software, every workstation had a piece of cardboard jury-rigged by the operators to form a canopy over the screen in an effort to reduce the lighting glare. To make matters worse, given the high cost of CAD management uses the equipment more intensively than it would otherwise. At London this has meant, for instance, a two-shift CAD operation whereas in the past drafting was basically a day job.

CAD Training

CAD is central to Northern's efforts at reducing the design interval and the overall manufacturing cycle. It is one of the most important new technologies in Northern's quiver and yet there is little evidence that its importance has been translated into training efforts. Workers are critical of the quantity of training, the quality of training, the discriminatory selection and the unilateral authority of management to determine who gets trained and what training is provided.

There are some CAD courses sponsored by Northern, and training to a degree reflects the efforts of individual managers, but for the most part it is considered inadequate. As one worker summed it up: "They woefully lack in training here."

There are no standards of training invoked by Northern and training initiatives are a mixed bag of after hours exposure, on-the-job 'hands-on', help from co-workers, assistance from worker/trainers as well as formal in-house or external courses.

In places there can be two workers at CAD terminals, one of whom has taken CAD training courses and the other who has not been offered the training. Some workers are expected to learn on their own time — in other words, if they want to make the transition to CAD they better stay after hours and get familiar with the equipment. Other workers are on CAD terminals and have never been offered any 'formal training'. Still others complain that although they have taken courses or had training during working hours, it was inadequate.

CAD systems are rapidly changing — there are new programs for 3-D modelling, more direct CAD and CAM (Computer Assisted Manufacturing) links, enhanced processsing ability and so on. At every location there are plans and projections but those who are working on the systems do not have a good sense of what the future holds. At one location a new software package was on the horizon, but as one worker said: "I don't know if we will be trained. We're not told that much."

III. IN THE ADMINISTRATIVE OFFICES

In Northern offices clerical work has come to mean computer work and formerly manual tasks are now done at a computer or not at all. Many in management consider computers as tools not considerably different than other office equipment. For them technological change is simply "going from a typewriter to a wordprocessor" and as such is no big deal. Workers are more discriminating in their assessment. "A tool is a tool" explains one worker, "but really there is a difference." That difference has to do with the possibilities technology provides for changing work flows, procedures, requirements of the job, and its impact on factors such as skill and advancement.

Impact on Work

Assessing the impact of technology is never a straightforward affair. It requires exploring both the technical and social dimensions of the workplace, sorting through the differences introduced by technology and those which are products of the organization of work. What exists as a technology-induced opportunity may end up truncated because of corporate culture or policy. What seems a technologically imposed limit is overcome by a change in the social dynamic of an organization. In such a situation peoples' reactions are as complex as the issue, responses as mixed as the outcomes. Northern workers generally greet the introduction of technology openly, their assessment of its impact is generally more favourable than not. At the same time their criticisms are incisive and their complaints penetrating. How technology is introduced, how it is used, the context in which it is applied, the attitude and policies of management all shape perception. Peoples' reaction to technology seems at times to be contradictory, but only because they address both the social and technical sides of change. In one interview a worker says succinctly:

> "It is so much faster now. The computer is so much faster and efficient than the manual system. It is much better to work with in the long run. There is responsibility with the job."
>
> Q. Is there a downside?
>
> "Boredom. I am so bored I could scream. There are days that I don't think I can take it."

There is a difference, according to this worker, between tasks and her job. While the tasks she does are automated, and she would have it no other way, the spaces left over and the repetition of automated tasks leave her unsatisfied.

Every job has technical as well as social aspects to it and outcomes are a product of both. Technology makes things possible but the social context defines them. It is not uncommon to hear peoples' mixed reactions to their jobs. One worker expressed a universal feeling when she said: "I like my job but there are so many 'ifs', 'ands' and 'buts' about it."

In the office the promise of the computer is its power to absorb routine and predictable tasks, and in so doing make life easier and work more rewarding for workers. This is the side managers emphasize. As one manager put it: "The theory says it should make jobs more satisfying . . . there should be a move from clerical to decisions." Another manager from a different location agrees: "It makes peoples' jobs more interesting. It replaced a lot of the laborious tasks like number crunching."

Throughout the clerical ranks and at each level in the grade structure there is evidence of both broader possibilities and restricted opportunities coincident with technological change. Some jobs are improved by the introduction of computerized systems but it is definitely not the case that automation upgrades all jobs. That there are different outcomes is not surprising considering the range of working situations at Northern — from department to department and, some argue, even "from desk to desk".

While technology is the occassion for changing job duties and tasks at Northern, it is not technology which restructures jobs so much as it is those in management who control the assignment of work:

"We had a girl on the graphic terminal and then she left and they decided not to replace her. So I was given some of her work and the rest went to another girl."

"I'm a grade 55. When I was in that job it was a grade 54. It was upgraded because I took over about 50% of someone else's job. He was a grade 61."

The majority of office workers, regardless of grade, associate new technology with more varied work, more responsibility, more interesting work and more job skills. But before too much is made of those trends, office workers are quick to point out the context: "When you are a grade 55 and you were behind a typewriter all day, how much more boring could it get?". At the same time as they point to welcomed changes they report an increase in workload, a faster pace of work and more boring and repetitious tasks.

Some workers report that new technology has freed them from routine tasks, while for other workers the sense of independence is either illusory, or management has intervened in such a manner that the possibility for better work evaporates:

"They have taken highly skilled jobs and they have made them so mundane. You call up a screen and you put a 'Y' or a 'N' and you enter it and it brings up the next screen and you change a part and you enter it. Those are grade 60 and 61 and they're sitting there half going to sleep."

The apparent ambiguity and seemingly contradictory responses of workers reinforce the conclusion that the effects of automation depend on the design of the technology, the nature of the job, management's intentions and the ability of office workers, either informally or formally, to influence the design and application of new technology.

Management Attitudes

Northern managers do not think much about job design or about the impact of technology on people. According to those who work for them, managers think about technology in terms of the efficiency of systems, about workloads in their departments, about headcount and about their own careers, but rarely about job design. As a worker put it: "So long as the work goes in and the work comes out they don't particularly care what happens in between."

Clerical workers complain about the workplace being management heavy and about the attitudes and the discriminatory practices of management. The range of concerns are reflected in the following comments:

"There is a management attitude that says 'oh, you are just a clerical. You are not important. I've got more important things to do than deal with you.' Support staff is not a priority for management."

"All these low level managers are out for brownie points, they don't care about us."

"The management in this place is the worst it has been in years. We never use to play games like this. The relationship between managers and workers has gone down the hill."

"You often hear managers say 'I don't want to stay here for the rest of my life, I want to move on.' But what about us? That is exactly what we want to do. They get higher because we make them look good."

While friction between workers and bosses is not new, nor by any means unique to situations of technolocial change, the point is that outcomes of new technology are determined in part by the climate in which technology is introduced. At Northern in the current period that leads to three conclusions. First, Northern has created a culture of change with little regard for the concerns of front line workers. Second, technology is applied as a technical solution and outcomes are constructed as technical outcomes and, therefore, as necessary ones. Third, technology is applied, at times, in such a way as to undermine and diminish those aspects of work that people enjoy — variety and independence within jobs, relations with co-workers and the potential for training and advancement.

Stress, Work Intensification and Insecurity

Technological change and the prevailing climate at Northern have combined to make offices stressful work environments. The stress is attributed to workload, to the insecurity of employment, to the pressures associated with the new systems and to unyielding deadlines. One worker

describes the stress levels: "When you walk through my department you can feel the stress." Another wants to distinguish between the work and the environment: "The work isn't stressful, it is the environment, the attitudes."

New information technology is capable of generating more information at a quicker pace than ever before. In fact the technology is capable of producing more than the the human system is capable of absorbing. As a result, some workers complain of a communication overload: "There are too many reports that you don't have time to look at." Others characterize it as "paralysis by analysis."

The new information systems are often introduced with the clear objectives of improving efficiencies and holding the line on staff levels. As a result workers end up shouldering the expectations. One worker expresses the frustration of many when he reports:

> "They implement these systems. They are always trying to reduce head count. They've got CI (cost improvement) cases. CI always relates to people. How many people are reduced? How much faster and sooner can it be done? Managers under the MED (management evaluation and development) always have a target for the department for CI's. Now we've got to meet these objectives even if the system isn't better than the last one. So now you have to have this report done on Thursday instead of Friday. That is happening all the time. It used to be Tuesday at noon, then it was Monday and now our deadline is Friday. That leads to pressure."

The new technology is a source of stress in what it does and in what it fails to do:

> "Pressure. The senior grades feel the pressure. You've got to make more quick decisions. Now you get a blip on the screen and now you have to make a decision. Before you had time to think. Now decisions have more impact."

> "You have to meet all the deadlines. There is a cut-off time. But when the system goes down — and it goes down — that doesn't change the deadline."

Centralization and Segmentation

The new office technologies emphasize the integrative aspect of information. But this integration does not necessarily translate into broader or more unified jobs. The specialization of office work — where work is organized as a small fraction of a larger function — can be, and often is, reinforced by computer terminals that are narrowly programmed, access codes which are very limited and software systems that require pre-programmed responses. These limitations are sore points for Northern workers:

> "When they introduce a new program they only tell you a little. They tell you to punch the keys but don't tell you what will happen. 'It's none of your business. You don't need to know' is the general response."

In such situations workers complain that their work is degraded. It seems that the requirements of the machine have been made more restrictive than the directives of management:

> "It can make your day to day life pretty boring and you are working to the beck and call of a machine . . . You used to have some responsibility and say, now you respond to the prompting of the program."

Workers are restricted in what they know and in what they get to do. One high graded worker, for instance, explains the computer system operates in such a way as to segment information and restrict access:

> "The password system restricts you. It's like you are given a key to the first drawer and someone else is given the key to the second drawer. That is how they

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isolate you . . . I had more decision making before. Now they tell you what to do and you follow it."

If one face of the new technology coin is segmentation, then its other side is centralization. While the system appears segmented from a workers' perspective, from a management perspective it is unified and access to information is now centralized. Managers now have greater access to the process of production in offices as well as an enhanced ability to monitor workers:

"On all of the screens you put your password, your employee number and with each screen you have to initial it."

"My manager doesn't have a terminal. He has a display phone. But he can actually key in and monitor my work. I was trying to figure out why there were a bunch of deletes on my orders. I know I didn't do it cause I wasn't there during the time. It was my manager could get into it. You know at what time and on what date a transaction at the terminal was made. It is all recorded."

"They have a computer printout of all the calls you made, to whom, etc. Some managers don't even look at it while some use it to monitor and talk to their workers. They have the potential to actually record our calls."

Credentialism and Mobility

With the advent of Management Information Systems (MIS) and integrated office systems Northern needs more of what management refers to as 'knowledge-based' workers. Management went about the skill transition in two ways. They upgraded, by means of both on and off-the-job training, and they hired people with the new qualifications. How Northern is going about the task of changing the mix of its workforce is having a dramatic impact on its current workers. Clerical workers argue that the established rules and regulations concerning internal promotions are being undermined by management through discriminatory practices and the introduction of unfair 'qualifications', and that the traditional patterns of advancement are being rejected in favour of hiring outside the ranks:

"They put the qualifications on due to what the company perceives as technological change, such as the software systems."

One of the easiest ways for Northern to shift its knowledge base upwards is to increase the qualifications for existing jobs. To do so it started rewriting job descriptions to include new qualifications. As one worker expressed it: "They want all these courses, degrees and qualifications." The introduction of these requirements has, according to many workers, ruptured the seniority provisions of the collective agreement and diminished the contribution of long service employees. The result is a dramatically altered sense of work:

"Experience matters less and qualifications count. It is the piece of paper."

"Ten years means nothing. In the past you could look forward to moving up, but not anymore."

"A person here 20 years — they don't say they have 20 years of experience, they say they have one year of experience 20 times. That is their logic."

"Under the old system you could go in as a trainee. Now if you don't have the paper qualifications you can't move. They would rather hire someone off the street. Either you have your CAPIC certificate or forget it."

Few people, even those who had CAPIC or PMAC really considered them necessary for the job. Some found

COMPUTERS AND CLERICAL WORK:

If you work at Northern Telecom chances are you are working with a computer. The computer has moved through the grade scale and into virtually every area of administration:

Rita is a grade 54 Data Entry clerk in Quality: "I'm on the terminal about 99% of the time. I input inspection results and distribute the reports. I key in repair tags, do time sheets, and I work at a graphics terminal."

Linda is graded as a 54: "I do secretarial and clerical work. I'm on a graphics terminal some of the time doing graphs and I'm on the wordprocessor where I do memos and at the terminal doing a bit of data entry."

Mary works in Accounting. She is a grade 55 and handles the 'payables'. She processes invoices to head office for payment, does some receiver investigations and deals with some vendors. About 75% of the job is at the terminal.

Gloria is a grade 56 who works in a software support function. She spends all day in front of a terminal: "I work at my own PC, at an IBM mainframe and I work with a variety of software packages. I'm in and out of two, three, four data bases a day."

Joan is a grade 60 Production Co-ordinator who spends about 60% of her day at a terminal. She works with the MRP system checking and releasing manufacturing orders, and checking parts lists and their availability for building the product she is responsible for.

Jacob is a grade 61 Buyer who purchases the printed circuit boards for a specified product family. He spends "about four to six hours a day at the terminal" placing orders, checking schedules and verifying changes on the PMS.

the courses interesting, even helpful, but disagreed with them being barriers to entry. Even a manager admitted that it may mean people end up "knowing more than we require." To encourage existing workers to get the educational upgrading Northern reimburses workers the cost of their tutition once they have completed the courses and passed the exams. The courses, however, are done after hours and on weekends and don't guarantee new opportunities.

Most union members strongly object to Northern's off-the-job training and complain that the company's obsession with credentialism is discriminatory and is being used as a justification to by-pass the union:

"There is more to life than Northern. They don't see a family life. You can get ahead if you go back to school. But we have families. It discriminates against women."

"You take all these courses and then you're still stuck where you were because they are not hiring anymore. People retire and they are not replacing them. We have to go back to get the qualifications but they don't make a commitment to us. Every night and every weekend I worked for those courses and I got them and I'm still sitting here."

"Qualifications stop lower grades moving up. You've got to pass the exams or you don't move. Some of our best people can't pass the exams so you are by-passed by someone who can. They move up the grade and then a layoff comes and you're out the door because you can't bump up a grade."

"If you are young its not a problem but when you have families it's hard to keep running and take the courses and then they don't guarantee a promotion."

Management has used the occassion of new technology to alter the composition of its workforce. At the same time it is using new technology to hold the line on clerical staff levels. For bargaining unit workers it means that mobility has been severely restricted and the expectation of something better in the future has been shattered. The realization of limited opportunities has hit office workers hard:

"Ten years ago it was easier to move. Now you are stagnant. You can see it in all the long faces around here. You get sick of bitching about it all the time but you can't help it."

"It used to be you could always look forward to a posting going up. You would know someone was leaving and have something to look forward to. Now I don't think I will ever get off my job. There is no where to go. I'm not going to last."

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CHAPTER FOUR:

FLEXIBILITY, LABOUR RELATIONS AND THE COMPETITIVE COALITION

Flexibility. Product flexibility, design flexibility, manufacturing flexibility, labour flexibility. In that one word Northern has summarized a corporate strategy and its agenda for labour. At one level flexibility is a coherent production concept; at another level it is a reflexive response, a reaction to competitive pressures and a resort to the unilateral right of management to manage. Either way, Northern is striving to become the flexible firm.

What productivity is to automation, flexibility is to work process changes. When managers speak of flexibility, implied is an unimpeded ability to deploy labour — to move people in the required numbers to where there is demand. It means that both the level of employment and its allocation are changing. In the first instance it is called numeric flexibility; in the second, functional flexibility.

Joyce started working for Northern at its London plant nine years ago. She has been laid off seven times since, and when measured in terms of continual service, Joyce has worked for only three of those nine years. Along with about 60 other workers Joyce was recently laid-off yet again. When she was recalled the last time, it was understood that it was a temporary recall. It just so happens that it was more temporary than expected. Although Joyce's work record is somewhat unique, her past foretells the future for an increasing number of workers. This is, in part, what is meant by flexibility.

Helen came into work one Monday morning after her vacation and found someone sitting at her desk. Her manager called her in to tell her she would not be there for a while. That was over a year ago. Helen was moved to someone else's desk in a different department because management needed that position filled and Helen had done that job at some time in the past. According to Helen, management is constantly moving people around: "I can honestly say that you can come in here on a Monday morning and not know where you are sitting." This is also part of what is meant by flexibility.

NUMERIC FLEXIBILITY

According to management Northern's demand pattern has shifted from one characterized by cyclical changes to one of rapid fluctuation. Not only is the lead time on orders much shorter, it is now more susceptible to change. What last week was a firm order this week is either cancelled or changed. Numeric flexibility refers to a company's freedom to change its level of employment in response to changing market conditions. In such a turbulent market Northern uses its workforce as a cushion against increased uncertainty. In turn that means an increased propensity to lay off and recall workers on relatively short notice, and in an unpredictable manner. In fact it has become so unpredictable that Northern has taken to recalling people on a temporary basis rather than laying them off on a temporary basis.

In the short term, numeric flexibility means that workers are hired, laid off and recalled with the ebb and flow of demand. It also means the company relies more on temporary workers to augment its regular workforce. In the longer term, it can mean a two-tier labour force within the company, with a small but permanent group of workers at the core of production and a temporary, part-time or fluctuating group at the periphery of the company.

The consequences of such a trend continuing are clear. It means precarious employment, either the insecurity of revolving-door jobs or the status of a temporary or part-time worker.

Layoffs

Flexibility already means insecure employment for a group of workers who are caught in the revolving door. Lower seniority people are laid off and recalled and never successfully accumulate enough seniority to feel secure.

A Brampton worker expresses concern that repeated layoffs have become a permanent feature of peoples' worklife: "Some people go through a lay off and then they come back, figure they are here to stay and then they're gone again." A London office worker confirms the pattern when she reports that: "some pople come back and then they're laid off and they're temporarily back and then they're gone, but they have an extension and then another layoff." A Kingston office worker hired nine years ago expresses the results: "I've never felt part of this company."

Some workers perceive Northern as intentionally establishing a polarized or two-tier labour force:

> "The way Northern is looking at it, they are going to have a full- time staff and a part-time staff. 'We'll lay them off when the work is slow but we'll get 95% of them back so who cares.' That is Northern's attitude."

Temporary Workers

The trend to numeric flexibility can also be seen in Northern's growing reliance on temporary workers. The collective agreements provide for the use of temporary workers in particular circumstances and for specified periods but workers and their union representatives argue that the company is using 'temporaries' in ways not

anticipated nor sanctioned by the contract. The complaint is that 'temporaries' are becoming a permanent feature of the workforce and, as casual workers, they do not have the same rights as full time workers and are essentially taking the place of permanent staff.

In the last round of collective bargaining the company unsuccessfully attempted to formalize a core and periphery workforce arrangement. The proposal was to create what Northern refered to as a "non-traditional workforce" composed of two categories of employees, 'part-time' and 'term workers' who would work 'as required' or for a 'specified period'. The proposal also envisioned the number of "non-traditional" workers as high as 25 percent of the permanent full-time workforce at any location.

FUNCTIONAL FLEXIBILITY

While numeric flexibility is a strategy for responding to fluctuations in the volume of demand, functional flexibility — the other side of labour flexibility — represents a response to variations in the mix of demand. A London manager explains the connection between the numbers and the functions:

> "Nineteen eighty six was a good year . . . but we didn't want to add the bodies. We're managed very tightly as far as the overhead. As a consequence of that we move some people around to meet the needs as they develop."

Functional flexibility is both a manufacturing strategy and a description of where Northern is moving its workforce. Northern's JIT and CIM agenda, for example, requires a flexible labour force; one that is flexible in terms of internal mobility and in terms of skills. In order to move people successfully requires workers with the ability to perform the work in the new job assignments. Since the operation is so thin, staff-wise, people will have to meet changing demands and to cover emerging requirements.

> "We move people round very quickly as a function of load, as volume changes both in the office and the shop. It means having to react quickly to those fluctuations in customer needs. Market shifts mean more movement of people."

Fewer Classifications

Flexibility requires breaking down what management perceives to be barriers to mobility. Such a strategy can be seen in the trend to fewer job classifications and larger analysis numbers.

At Brampton, between 1981 and 1987 the number of analysis numbers was reduced by close to one third. In the grade 5 ranks the number of analysis numbers was reduced by 40 percent while the actual number of workers in that grade was increased by 74 percent.

At London in 1987 the largest analysis number accounted for almost one third of the workforce in a particular grade. In 1981 no analysis number accounted for 10 percent of the workforce by grade. One manager explains:

"There is more flexibility associated with having more people in an analysis number so one of the ways to increase flexibility is to have more people share an analysis number."

The grade structure is subject to the same corporate efforts. A worker, in reference to Brampton management, makes the point: "What they want is four grades across the shop. Now we have eight and they say they want to cut them in half."

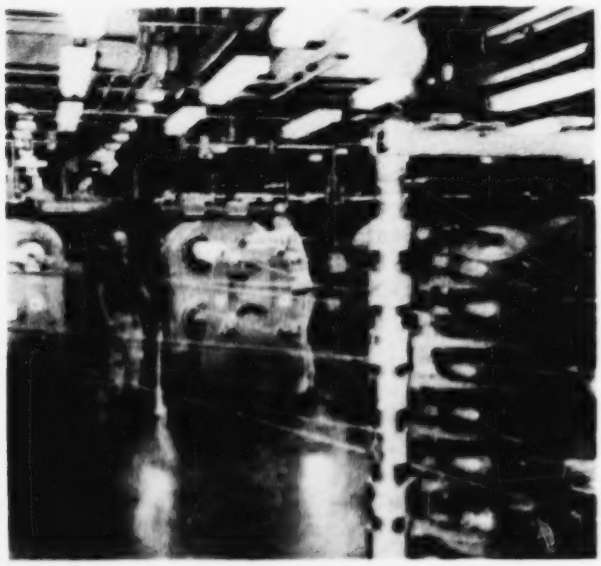
Bigger Jobs

Another component of Northern's flexibility strategy is to increase the range of duties workers are expected to perform. One manager explains that "there are more activities being included in a job function. People are rotating through different activities." This practice of multi-tasking is, in part, what is meant by concepts such as multifunctional workers, cross-training and generic job descriptions. Functional flexibility requires combined jobs and more general job descriptions. A manager makes the point:

"The jobs will have to be more general and the training and retraining will have to be greater because you want more generic broad jobs."

And it means that direct labour becomes a mixture of direct and indirect duties as workers take on additional responsibilities — slide line workers inspecting each others work, set-up operators in the line card area doing minor repairs, testers performing repair duties, and workers generally being responsible for more housekeeping functions:

"(Under) the new system in the cold room we were told that we would be responsible for getting our own work from the previous stage and then when we are done with it and the final inspector is done with it they take it to the stockroom."



Northern Telecom

"I go where I'm needed. This morning I was running the VCD, then later on I was running the wave and wash."

"If they need a layout in another area then that is where you go."

"In trades they want one instead of three trades. It has already happened in my department. They have combined an electrician and a mechanic and called it a technician."

"In Flexible (FMS) there are twelve machines and you have to know them all."

FLEXIBILITY: WHOSE TERMS?

In its quest for flexibility Northern management has merged analysis numbers, established work cells, introduced job rotation, combined job categories and mounted communication campaigns and JIT training programs. The issue, however, is not whether more flexibility is necessary or whether there are too many analysis numbers. The issue is how flexibility is achieved and whose interests it serves. For workers the concerns involve both the process and the outcomes -- what the safeguards are, how explicit the benefits and costs, how negotiable the tradeoffs and the compromises. What matters is whether flexibility reduces workers' rights or limits the union's ability to protect their interests.

At present the drive for flexibility conforms to the very patterns that management argues are breaking down — the "management acts and the union reacts" school of industrial relations. In the process of achieving flexibility there is little discussion. Instead management decides it is necessary and then goes about instituting it.

In promoting flexibility management puts itself on the side of reform and portrays workers as hanging on to outdated roles. Three local managers provide the following comments:

"Whereas years ago it was alright to have someone just do a tiny piece, it is now important that people can do a broader spectrum of activity. But it also relates to their own satisfaction. Over the years enough studies have been done to show that people who just do this one piece on one piece of equipment are not satified, that activity of a repetitive basis day after day has got to turn something off in the grey matter."

"Absolutely, that's what we are talking about and its good for the people too, once they accept the fact that they're not going to have just one little niche, one little corner."

"Those little protected enclaves of employees doing the same thing day in and day out for so many years are a thing of the past. The future is ability and flexibility."

In describing their jobs and some of the contemporary workplace practices workers suggest that there is

something both ironic and self serving in management's current arguments for change. At the same time that managers criticize workers for their narrow work concepts and strict job rules, they complain about the disruptions caused by job postings and the mobility provisions in the collective agreements. They criticize workers for staying in the same spot year after year and they criticize them for moving around too much. It is not surprising, then, that workers greet the current flexibility efforts with suspicion. "Flexibility," concludes one worker, "is strictly for the company's benefit. It has nothing to do with us. It is not to make our jobs better." In fact, flexibility is often viewed as an attempt to roll back the clock to a time when management acted independently of workers and their unions. "Management," concludes one worker, "wants to do what they want to do when they want to do it."

The history of industrial relations, within Northern but more generally as well, is one in which there have developed some joint procedures for regulating the use of labour within the company. The rules and procedures governing matters such as hiring and firing, promotion and advancement, classifications, job rules, seniority, bumping and union rights have been developed so that workers have some say in the practices which govern their work lives. Some workers see the current management strategy as an effort to undermine some hard won rights. For example, workers argue that if management has the right to continually move people around then the posting provisions of the contract are weakened. "We post for our job", explains one worker, "because we want that job and we do it the best we can. If you don't like the job you can post." Workers post for particular jobs for a variety of different reason — better pay, better shifts, better managers, more interesting work, more skill, relationships or the need for a change — but whatever the reasons and whatever the outcome the contract provides them with the opportunity. "It's my job", declares one worker, "I've worked hard and trained for this job. I've been here 15 years, it's taken me this long to get to a job that I want to do." In that statement is expressed the concern that in the flexible workplace all the jobs will belong to the company, and in the words of one worker: "We will be Just-In-Time workers."

The debate on flexibility reflects a struggle in the workplace over mobility and control over the movement of people. One worker speaks for many when she argues:

> "The constant movement is hard on peoples' nerves. You get a job you like, you like working with the people you work with. We like to feel that we are in control of the greater part of the day."

There are those in management who concede that it does pose hardships and who recognize the shape of the struggle. One manager expressed it this way:

> "People don't like to move off a job they've elected; they like to know where they are going to be next month or next year. But it is a fact of life. That is the way the business operates, it is efficiency and we need people to be more flexible in order to do the things we have to do."

The criticism of flexibility is not simply a theoretical one. Workers argue they have enough hints to know what it means in practice:

— On combining jobs one worker explains Northern arithmetic: "Around here if they combine a nine and a five they get a six."

— On skill enrichment: "They got rid of the grade 3 and 4, and put it all in the grade 5."

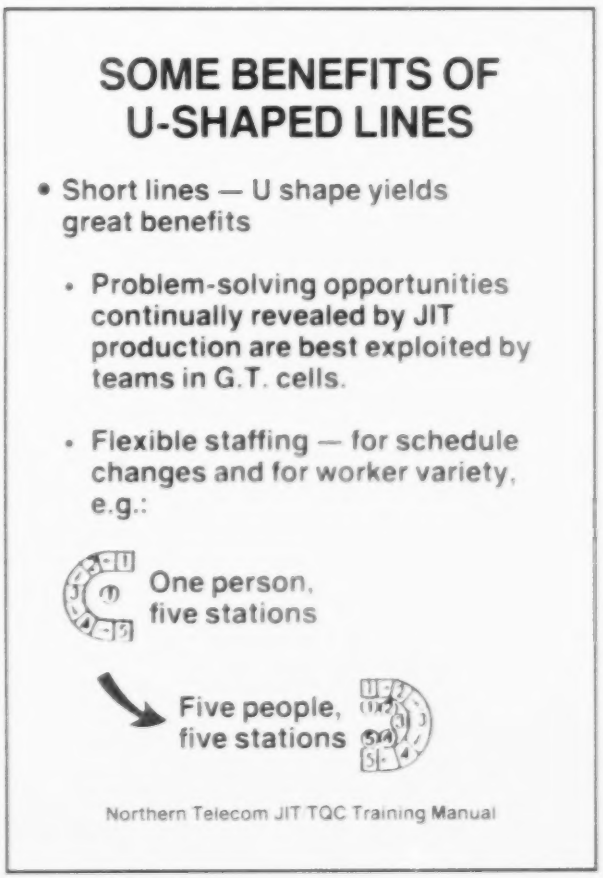
— On additional job duties and upgrading: "There are a lot of functions we do that aren't in the write-up. We bring it up with management, they don't upgrade the position they just change the write-up."

— On the rights and privileges associated with jobs: "We asked that since we were going to be doing the duties if we would be given the analysis number of those who did the job and we were told, 'No'. They make us do the job but then they say we aren't qualified for the analysis number." In other words, in a layoff, for instance, they wouldn't be considered qualified to bump into that analysis number.

— On merged analysis numbers and mobility: "If you get surplused off one line onto another one you can't post back onto the old line because you are the same analysis number."

— On the results: "Flexibility is everybody doing everybody's job". And again: "It's disruptive. It's just stress."

What increases flexibility for management may limit it for workers, and despite the language of job enlargement and skill enrichment many workers see flexibility as


SOME BENEFITS OF U-SHAPED LINES
• Short lines — U shape yields great benefits
• Problem-solving opportunities continually revealed by JIT production are best exploited by teams in G.T. cells.
• Flexible staffing — for schedule changes and for worker variety, e.g.:
One person, five stations
Five people, five stations
Northern Telecom JIT TQC Training Manual

restrictive. Work becomes more structured, jobs more standardized with stricter timing and are characterized by a loss of control and a reduction of freedom and manoeuvrability:

> "They told us that our flexibility is gone when we go to the cells. We have to stay in position until scheduled breaks."

> "We don't have a manager breathing down our throat. We do pretty well what we want to do when we want to do it. As long as we give them 40 hours. The concept in department '53 is you're totally watched, all the time. You get a ten minute break in the morning, but you get back and ready to run when your ten minutes are up. It's a completely different world. People are scared, they don't want to be up there, they don't want to work like that."

Management flexibility efforts intrude into the informal organization and control of work in various places:

> "We used to sit down and organize it so that operators would be on different routines from week to week. It made it better for everybody. We'd sit down and sort it out. People would move from a heavy job to a light job. It worked nicely. We had pretty much a free hand until recently . . ."

At the same time that workers see their interests ignored and their chances for advancement curtailed through the imposition of new qualifications and a general downsizing of the labour force, they see management creating protected jobs that cannot be bumped, preferential positions such as the supertrades, more excluded jobs, and more insecure employment for many workers. In such an environment the debate around flexibility is a debate about workplace rights: Mobility on who's terms? Rotation on who's terms? Cross-training on who's terms?

Northern has recognized that the benefits of flexible production and flexible technology can only be achieved by a flexible labour force. There are those in management who believe that flexibility requires a different approach than the current one:

> "The only reason it makes sense from a management point of view is if you are going to use people in a broad sense and you are committed to the idea of involvement. If you don't use it — then the benefits such as reducing intervals, improving quality — you'll lose it. People aren't going to give you those improvements if they don't have the skills first and if second they are not involved."

In other words, in a computerized workplace characterized by a Just-in-Time production philosophy and an ongoing commitment to product and process improvements, production requires the timely and appropriate interventions of workers. Production requires fewer workers but it requires more from them. The question for management is whether the trust, security and confidence of workers is a precondition for the changes in the workplace and, if so, whether flexibility will be a negotiated process or a resort to managerial prerogative.

COMMUNICATION

Situations of technological change are often situations of organizational change. New production concepts and technologies — JIT, CIM — require a new style of workforce relations. At Northern that gets expressed as a change in managerial approach.

The primary objective of the new managerial style is to change the relationship with employees. In the words of one manager the goal is to "improve the direct ties, to establish closer ties between the company and employees." Another manager notes that the Human Resource office was moved onto the shop floor "to be closer to the people and where the problems are." And Another manager talks about migrating workplace relationships "from labour relations to employee relations."

A second objective is to change the relationship with the union. One location, for instance, relies more on 'ad hoc' meetings to resolve problems. At another location management reports a more "informal approach to resolving issues."

Central to the strategy is the launch of new communication programs. These initiatives are part of the continuing effort to create a company-centred workforce. The push for flexibility is a step in that direction. The creation of job categories unique to Northern ('supertrades') and the development of company- specific skills is another step. Communication programs are a third step. Among the initiatives are information sharing sessions,

Jeff Carroll

departmental meetings, employee attitude surveys, newsletters, videos, workplace improvement projects, problem solving groups such as "Team Excellence" and "Working Together" sessions. The goal is described by one worker:

> "They are trying to get you to put more trust in them. It has always been them against us and now they are trying to get on our side."

The Competitive Coalition

Communication is the bridge between the targets of the company and the loyalty of the workforce. "We are still in the process of cultural change" states one manager. "We have to recognize that we are all in this together." Another manager makes the case more directly:

> "We are developing communication programs. People have to know what is happening with the competition and the changing climate outside the company. We've been isolated but we can't be any longer. The Japanese and others are trying to break into the market."

Identification with the interests of the company against its competitors has become a new feature of labour relations and the foundation for an alliance — a competitiveness coalition — between workers and managers. Senior managers talk about efforts to build the common realization that "we are all employees" and the real issue is not the "battle within the company but the fight against the rest of the world. We must work together to compete against the rest of the world."

The ideology of competition is being driven home. It has become a prominent feature of the workplace. Managers hope to convince workers of the need to accept the management agenda for change, what some in management refer to as a more "congruent set of objectives":

> "We've learned that if we only get co-operation from people, if we make people aware, educate them more, then people understand we are managing the business properly."

Workers' reactions to the efforts are mixed. They joke about the bribes:

> "They are giving us T-shirts, a sweatshirt, a cap, a key ring, a scarf, all in the last year. We almost don't have to buy clothes. And you get the choice of 12 different colours of scarfs."

They admit there is now more information than ever before:

> "People are getting more information than before. They are telling us things."

But as another worker points out:

> "Getting more information and things doesn't necessarily make it a better place to work."

In the new communication initiatives the benefits for workers are more involvement and more information. The risk is less solidarity and fewer workplace rights. For management the benefit is a committed workforce; the risk is greater vulnerablity:

> "The workforce has to respond to the changes. You don't ask and not listen. There is a price to involvement. People can smell it if you are bullshitting them. You have to build up credibility over time. Credibility is hard fought and easily lost."

LABOUR RELATIONS

There is more information available in Northern and there is more sharing of that information. What in the recent past was considered privileged managerial information is now considered "people information". Northern gives workers and their unions presentations on forecasts — loads, run rates, sales — things that "before would never be heard of." According to managers the changes are significant and point to management's good intentions. A tired but favourite line is "we are not perfect but we are improving."

For all the change there remain large areas of disagreement. Often what management considers shared information and open access is not what local unions consider relevant or important. In various locations there is a simmering dispute over what information should be shared, and it occassionally boils over.

On the one hand local unions claim they "are being kept out of the process" while on the other hand managers claim they are giving more than ever. It is a positional difference. At one level it is a debate over the kinds of information and the forums for its exchange. At another level it is a dispute over participation. The company is willing to provide information about orders, loads, products, quality, targets, and what the competition is up to; the union wants to know about and have some say on job and job-related changes in the workplace. The difference in perspective and the prevailing paternalism of management is reflected in the following comment from a local manager:

> "Depends on what information you mean. We want to make employees aware of where the business is going. We may take a guess at the volume of people that will be required but its purely accidental if we get to that figure. If we publish the figure — there are too many variables. Things change so quickly in this business. It's a judgement call we make each time we communicate with people. We tell them as much as we think will be beneficial to them and healthy without raising hopes or fears."

The Process of Technological Change

At Northern, as elsewhere, it is in the process of technological change that good intentions and commitments are put to the test. According to workers management does not handle change very well. The way management introduces new technology puts considerable stress and strain on people. Criticisms range from front line supervisors not knowing what is going on to their

unwillingness to tell people what is going on, from managers using situations of technological change to achieve social objectives to workers being ignored, or worse, misled:

> "When you ask them specific things they will say, 'I'm not too sure about that.' They set things up and worry about the problems later. We've said that the union is going to be in here all the time as a result of what they are doing and they say they will worry about that when it happens."

> "They don't tell us the truth. It changes from day to day. We sort of have to hear this from co-workers. No one sits down with us."

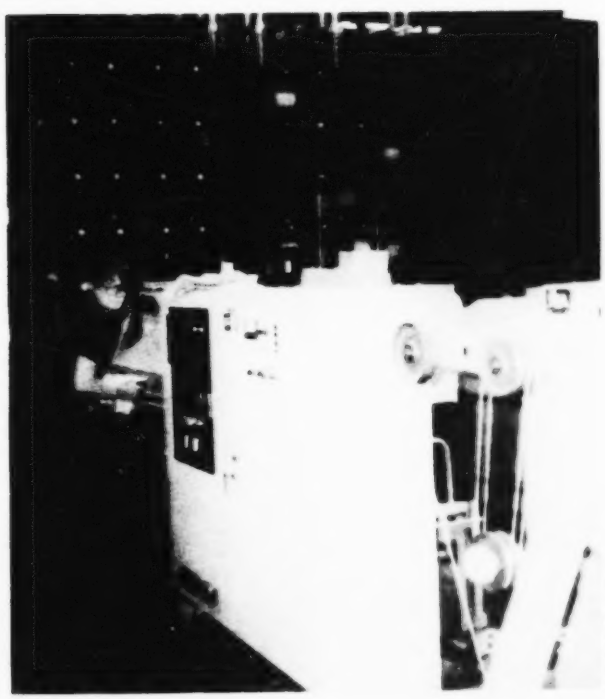
> "Nobody knows what the hell is going on!"

> "All of a sudden it is there. That is how we are told about changes. 'Here it is, all you do is push that button and then this one and it comes out'. That is how they do it. It is a recurring thing."

> "No one ever tells you."

Although the criticisms are situation-specific there is a general pattern. When it comes to information about impending changes there is too little, too late and often not the right kind. Furthermore there is an acute sense of being excluded from the process:

> "They make decisions without consulting you. You are the person who does the job. Why don't they sit down and talk to you? You are not stupid, you could probably come up with some good ideas."



Northern Telecom

> "It wouldn't be so bad if they came in and said a year down the road 'this is what we are going to do'. But they don't. They tell you after they do it. We are not going to be able to stop technology. We are not going to stop change. But at least they could tell us what is going on. They keep everybody in the dark."

Consultation and Technological Change

The Flexible Manufacturing Development Centre (FMDC) at Brampton is a symbol of the high technology aspirations of the company and a symbol of the wrong way to implement technological change. When the FMDC was installed management proceeded by constructing a room in a corner of the shop, putting in security coded doors and when the equipment arrived and the line was being set up it painted all the windows black so no-one could see in. Management now admits it was the wrong approach. They rationalize the decision — "it was pretty developmental, hush hush stuff" — but they distance themselves from it by saying: "It was a big mistake."

Despite the claim that the situation has changed quite dramatically since then workers and their unions are still kept outside the process. Perhaps it is true that management is more willing to tell people things but it is not the case that there is more worker involvement in the process of technological change. The distinction between 'telling' and 'involving' is demonstrated in the following management account of when workers are brought into the process:

> "The judgement is that you want to tell people as much in advance once we know what we are really doing. It's really unsettling to sit down and tell people this is what is going to happen and then two or three weeks down the road tell them it is not. It creates the impression that we don't know how we are managing the business. So once a firm decision is made we let them know. That is one of the reasons we established the monthly department meetings. As soon as we know what is exactly going to happen we ask the managers to let their people know. As far as possible after project has been finalized. There are many, many changes that take place in the planning process. If we know for sure that something is going to happen six months from now we will tell them but if we don't know until a week before then that is when we tell them."

Northern describes itself as a company "that operates on technology." But for all that — or perhaps because of it — Northern firmly resists arriving at a definition of what constitutes technological change in its own operations. Northern managers can't shake the impression that the union is a brake on technological change, always trying to slow it down or prevent the company from taking action it considers appropriate and necessary. As such management wants to so restrict the definition of technological change as to make the concept meaningless in collective bargaining terms. It has been successful. In a company chock full of new technology and in an environment of rapid and recurring technological change, Northern has managed the transitions without recourse to the technological change clause in the collective agreement.

BUT IS IT TECHNOLOGICAL CHANGE?

The convolutions and the ramifications of Northern's stance on technology are clearly demonstrated in the following lengthy, but interesting, exerpt from an interview with a local manager:

"**Q:** Do you have a stated corporate policy on handling technology layoffs?

A: We don't have technology layoffs . . . We have surplused people not so much from technological change, as you call it, but from load. What I have seen is that surpluses from changes process evolution, product evolution have resulted in small pockets of people relocated or posted to other positions. We haven't had a layoff as a result of technological change as you call it.

Q: Process evolution? That is tech change isn't it?

A: We don't think of it in that way . . . In terms of technological change, that would be a more major effort, a real change to product, a major impact change. But what tends to be reality is that things evolve. You don't have something on this day and then you set up new lines and do something else different.

Q: What about the Flexible Manufacturing System in Brampton, was that a technological change?

A: No . . . We've had to look at the issue from an industrial relations perspective. Arguing constantly with the union as to what is tech change. We've certainly addressed it divisionally and there is a lot of things that we don't consider to be tech change. We consider it to be product or processs evolution.

Q: But then what is a tech change? If you wipe out changes to process, changes to products, what are you left with?

A: There is a difference between a change to a product and a changed product. The closest thing to tech change that we've had is the switch from analog to digital. That was a significant change. It was a new product, a new process, everything was different. It was software driven . . . to me that was tech change. I don't see the ongoing changes which supplement that product . . . which makes it better, faster, and so . . . as being tech change. That is evolution.

Q: If you were at you're desk writing out invoices and next week you did it at a computer terminal, is that a tech change?

A: No, that's a new tool I have at my disposal.

Q: Is there a reason for this attitude?

A: Okay, in our viewing, if something is tech change or not there are ways and means that unions will want to deal with tech change. In that light we have to then say 'what is it we're going to look at as tech change'. A company probably could cease to operate if every changed process, if every time somebody automated something, or if every time some effort was decentralized because new systems were brought in place, if in all those cases the company had to act as if that were a tech change provision of the collective agreement, you couldn't function . . . It's usual under cases which happen in collective agreements, there is usually some special provision to deal with it. That would, quite probably, in a place like this where people have new tools at their disposal on an ongoing, daily basis, if people wanted some special treatment for that . . . I don't know how we would function. It's more a question of adaptability to those changes.

Q: How do you reconcile that perspective with the new communication philosophy of the company?

A: We do tell people about how the product and the process are evolving. That's important that we communicate that. The only place that we are differing is that to us that is not tech change it is more a case of product and process evolution. It's still important to communicate it.

Let me give you an example. We have switched from having a keypunch department to inputing at source . . . Instead of manually logging it we key it in at the terminal at the source department. That has an impact on the keypunch area. The union would say that is a technological change but we would say that the keypunch people have been impacted by the fact that people are using a new tool or process to do what we were already doing. For a lot of the cases it is something that we have already been doing.

Q: If the union calls that a tech change and you call it an evolution, what is the big deal about what you call it?

A: Maybe it's strictly from the standpoint that as the years go on there will probably come a time when this whole concept of tech change, how it impacts people and provisions in agreements, will become more focused and more important and at that point companies and unions will have to come to some understanding of where tech change language gets enforced. I would say that is not clear yet . . . we're still struggling with that.

Q: It is hard to be clear if you have a corporate position that says nothing you can think of is a technological change, then it is hard to arrive at a common understanding isn't it?

A: I'm not saying 'nothing'. I've given you an example of what might have been considered a technological change.

Q: How about the coming shift from DMS-100 to ISDN, is that a similar situation? Is that a technological change?

A: No, I don't think so. . . . It's expanded capability of our existing product.

Q: How about the shift from wire cable to fibre optics?

A: No.

Q: How about a robot?

A: No. It's a process evolution or another way of doing something we already do. Maybe the words are used freely. . . from an IR point of view we don't use the words freely because it is a pretty important subject and you've got to look at it. It's something we're struggling with.

Q: What is the company threatened by? What doesn't it want to do?

A: The company is willing to retrain but not reskill. . . . If someone was surplused from the salaried ranks and exercised their bumping rights, the company would never say 'okay, we will train you as a typist'. That's a skill and the person can go outside to get it, but if we introduce a new wordprocessing system the onus is on us to train, but we don't think we have to provide the basic keyboard skills. That's where it all comes down to. That befuddles the employees sometimes because there is a tremendous expectation to reskill."

CHAPTER FIVE

THE NEXT DECADE

In Northern workplaces, at least in the short term, the major computer-based automation initiatives have already occured. No doubt there will be future changes — the development of onserter rather than inserter technology, the shift to photonics from electrical/electronic, the development of new software systems, the introduction of ISDN (Integrated Services Digital Network) — but many of the workforce impacts have already been experienced. This is not to suggest the issue is resolved, only that there should now be greater awareness and a better ability to predict the outcomes and consequences of future technological change.

In the current period the emphasis has shifted from computer-based changes to those resulting from changes in the organization of work. These changes, in turn, will suggest and give way to new automation initiatives as Northern continues its efforts to integrate systems and functional areas within the corporation.

Over the last decade the rate of change at Northern has been tremendous, its reach extensive. The question is whether lessons have been learned which will help guide future changes. Out of the current period of technological and organizational change has emerged a number of workplace issues. These concerns can be grouped into three sets of issues which address the process and outcomes of technological change. They are economic security, involvement and good jobs. How these issues are resolved in the short term will determine whether workers will be better or worse off in the coming decade of change.

JOB SECURITY AND TRAINING

In Northern there exists a technological change paradox. The opportunity for secure jobs has never been greater but most people feel more insecure about their future. The introduction of new products and the application of new equipment and processes provide the means for establishing secure jobs and yet those same developments threaten peoples' jobs.

Northern has successfully and dramatically reduced its labour costs. Northern has more sales with less workers, more output with less workers, more profits with less workers. Labour costs as a factor of production are becoming less and less a determinant of anything. It is clear there will continue to be pressure on jobs from product

Jeff Carroll

design and changed processes and procedures but pressure on jobs can be independent from pressure on people.

There are those in Northern management who view the issues of technological change and job security as antithetical and who believe that it is the people who have to give in to the law of labour mobility:

> "People will have to change their perceptions of ties to a particular plant. Plant lifecycles will shorten in the future and people will have to accept that past perceptions of lifetime employment in a particular plant no longer hold."

This particular manager goes on to say that "acceptance of this need for relocation should be taught in school so that younger people get used to it." This is precisely the type of reasoning — one that sees the benefits of technological change unevenly distributed — which guarantees friction around the issue.

Northern expects a great deal from its workforce. The expectations can be found in the adjectives used to describe it — adaptive, flexible, creative, skilled, motivated, committed. But the price of a committed workforce is a commitment to that workforce. That means a change in attitudes and practices. It means uncoupling the narrow equation of new technology and labour cost improvements, it means shifting the social objectives away from the 'headcount', and it means making a distinction between credentialism and qualifications. Most important it means a clear commitment to the current workforce on two fronts: employment security and training. The productivity gains already achieved and those anticipated for the future can provide a new basis for sharing the benefits of technological and organizational change.

INVOLVEMENT

Outcomes of technological change are variable. Part of the variability is a product of the relationships between technical and social systems. Briefly stated, technology can influence policies and policy can influence technology. Technical requirements can shape social designs and social requirements can shape technical designs. What you choose to do and how you go about doing it are important determinants of outcomes. In workplaces the goals of technological change and the process of technological change matter.

From a common sense, practical point of view there is enough evidence to support the view that changes based on co-operative efforts are more successful than those based on unilateral management action. In fact, there is a 'best practice' emerging in the literature in terms of the process of technological change. The best practice is based on a recognition, and greater planning, of the social aspects of technological change and on the early participation of all those involved and affected by the outcomes of change. Some managers in Northern have pointed out that workers not only accept new technology, but before long, start making new demands on it. That is not a sign of resistance. Indeed the resistance is not to the technology but to the process and its outcomes. 'Best practice' principles address these concerns.

But involvement in technological change has to mean more than consultation. There are benefits in technological change that can be considered as mutual. Where workers' and managers' interests coincide, so much the better, but technological change also creates conflicts. There are times when the interests of the workforce are *different from those of management*. At such times it is important that the conflicts be made explicit and that ongoing collective bargaining procedures are developed which allow the conflicts to be resolved.

A recent study by the Economic Council of Canada concludes that the level of consultation on technological change and the degree of joint regulation of new technology is deplorably low in Canada. In *Making Technology Work* the Council states:

> "Our review suggests that there is not enough real negotiation over the introduction of new technologies and their impact. Technology related provisions are relatively infrequent; and, where they do exist, they tend to be weakly enforced."

The Council goes on to state:

> "Genuine collective bargaining over the implementation of new technologies is an important policy objective . . . The approach must encourage joint involvement and decision making . . . Such a framework is essential if Canada is to cope effectively with the pace of change that we anticipate for the future."

One of the obstacles the Council sees to genuine participatory approaches to technological change is:

> ". . . the presumption that the introduction of new technologies is a managerial prerogative, as well as from the inability of unions to treat this issue as a bargaining priority."

At Northern Telecom the presumption of managerial prerogative is firmly developed while the processes of consultation are tentative and fragile. It would appear that there are those in Northern who would disagree with the Economic Council's argument that "employers must be prepared to involve workers and their representatives in the innovation process, which implies giving up some control over what has traditionally been managerial prerogative." The challenge for Northern is to move beyond communication programs to effective worker involvement and strengthened procedures of collective bargaining.

GOOD JOBS

Both workers and managers freely admit that certain tasks are better automated. In that admission is the recognition of the relationship between new technology and job design and the distinction between good jobs and bad jobs. Managers and equipment designers do not pay a lot of attention to job design. To the degree they do it usually amounts to ensuring that a particular job is "fully occupied". But jobs are designed whenever systems are designed or changed.

At Northern the language of good job design is employed to rationalize changes managers want in jobs whether or not such changes increase job satisfaction. But the measure of job design and effective technological change is the ability to create good jobs in the work place. In order to do so requires a different approach to new technology. It requires starting from the workplace and then determining the appropriate technology.

In the design of jobs particular attention needs to be paid to three aspects of what constitutes a good job — the content of jobs, working conditions and the working environment. From a starting point of safe and secure jobs a list of job features can be constructed. Without being exhaustive, the list would include:

- the opportunity to see the contribution made by one's work,
- the ability to vary working methods and the pace of work,
- the opportunity to use and develop skills and knowledge,
- the abilty to influence the amount, timing and quality of one's work,
- the opportunity for advancement and job changes,
- the opportunity for good communication and contact with co-workers,
- the opportunity to work in a developmental climate with supportive worker-supervisor relationships.

There are enough examples in Northern where people have concluded that their jobs are better following the application of new technology, and enough examples of jobs being made worse as a result of technological change to warrant careful attention to the job design implications of new technology. A clear and straightforward starting point is in the area of ergonomics. There is enough known about VDT's, for example, to design and construct appropriate workstations and to organize computer-related work in such a way as to reduce the stress and strain associated with terminals.

Managers at Northern have stated that they no longer want to "hire people just from the neck down." That puts a clear onus on managers to respond to what goes on in peoples' heads, and that means designing better jobs. When workers at Northern are canvassed about their reactions to technological change the results are mixed. There are clear benefits attributed to the changes and there are clear costs associated with them. The costs include a loss of freedom and control, a distrust of managements' objectives, a loss of skill, restricted jobs, intensified work, the growth of insecure employment, loss of opportunities for advancement and personal doubts about ability to perform.

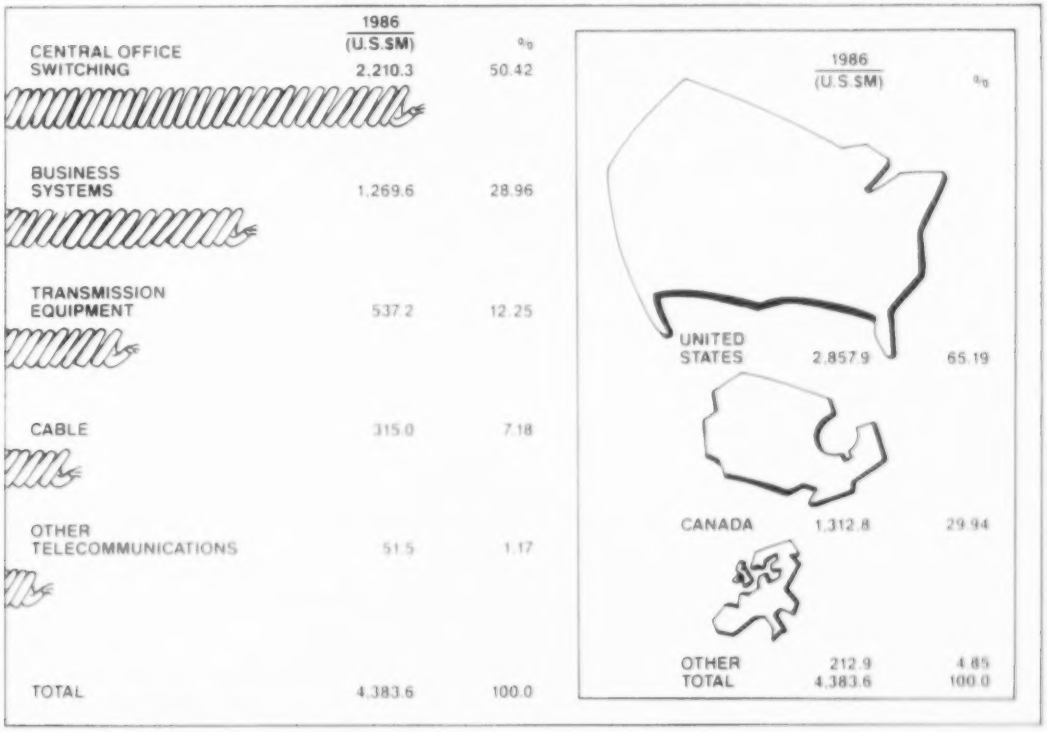
It is because the costs are known that they can be avoided. The next decade of change can be guided by a different set of principles: a commitment to employment security, a commitment to upgrading and training, a commitment to involvement and negotiation and a commitment to good jobs.

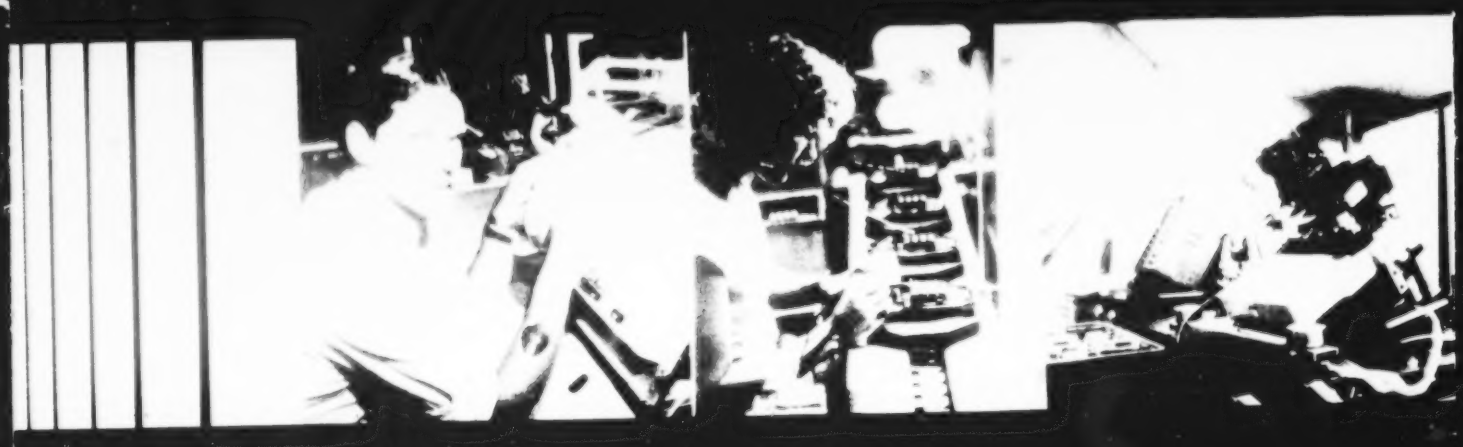
NORTHERN TELECOM
Revenues, Profit and Employment

YEAR	REVENUES (million C$)	INCOME (million C$)	EMPLOY-MENT	REVENUE PER EMPLOYEE (Cdn. $)	INCOME PER EMPLOYEE (Cdn. $)
1974	$957.7	$53.8	26,147	$36,627	$2,057
1975	$996.8	$70.2	23,751	$41,968	$2,955
1976	$1,083.5	$73.9	25,277	$42,865	$2,923
1977	$1,221.9	$80.9	24,962	$48,950	$3,240
1978	$1,504.6	$87.7	31,756	$47,380	$2,761
1979	$1,900.5	$111.2	33,301	$57,070	$3,339
1980	$2,054.6	($21.3)	31,915	$64,377	($667)
1981	$2,570.9	$113.2	35,444	$72,534	$3,193
1982	$3,035.5	$132.4	34,449	$88,115	$3,843
1983	$3,304.0	$227.1	39,318	$84,032	$5,775
1984	$4,378.6	$333.9	46,993	$93,175	$7,105
1985	$5,818.5	$411.4	46,549	$124,997	$8,838
1986	$6,051.6	$432.4	46,200	$130,987	$9,359

SOURCE: Calculated from Northern Telecom Annual Reports

REVENUES BY PRODUCT AND REGION





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